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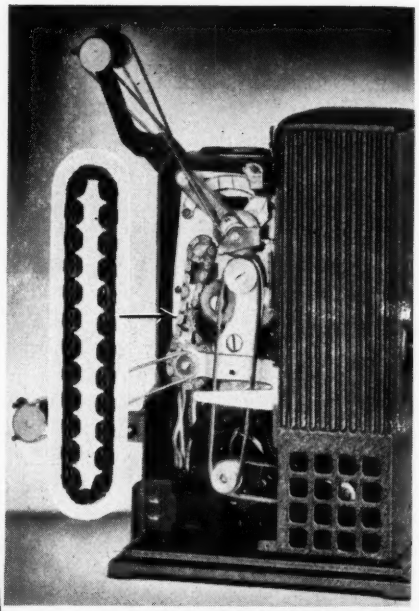

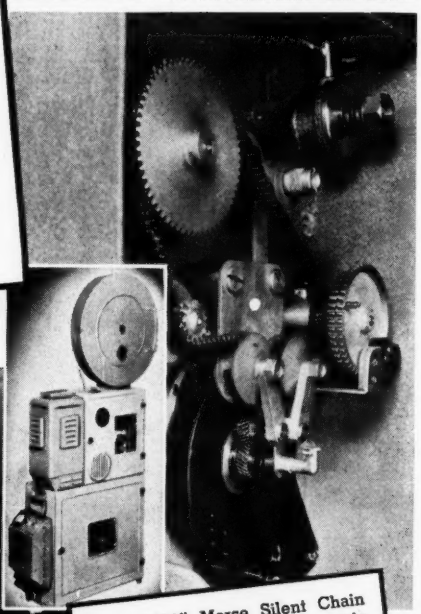

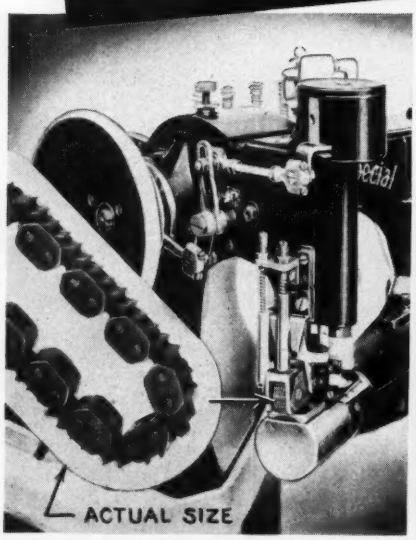

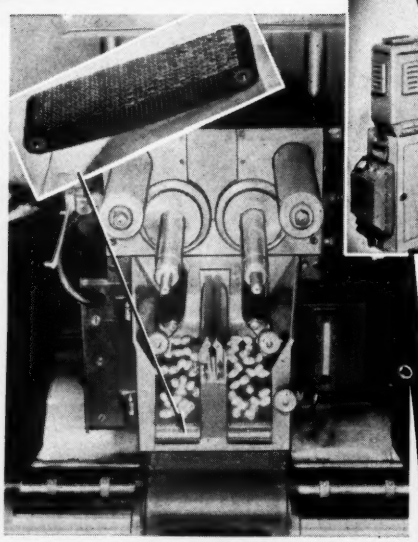

Top—3/16" Morse Silent Chain insures perfect timing on movie projector.

Above—Tiny Morse 3/16" Silent Chain drives this movie camera with complete dependability.

Extreme Left—This chain, shown actual size in inset, does a special job well.

Left—Here is 3/16" pitch Morse Silent Chain used as carriers on a gelatine capsule making machine.

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AMONG OUR AUTHORS

William Warrick Fineren, native of New York State, was graduated from Cornell University in 1902 with the degree of Mechanical Engineer—subsequently served for twenty-three years in the U. S. Engineer Department as a river, harbor, and fortification engineer, until his voluntary retirement in 1925. During World War I he was in resident supervision of engineering construction at the defenses of Key West, and Tampa, Florida. In 1927 he removed from private practice in Jacksonville to the University of Florida to accept the chair of Assistant Professor of Civil Engineering, and in 1929 the position of Assistant Professor of Mechanical Engineering. In 1937 came promotion to the full Professorship of Mechanical Engineering. Since 1927 public service has called upon him several times, notably as a member of the National Resources Commission, and as a member of the Florida Board of Engineering Examiners, in both of which he still holds membership.

Alumnus Fineren is a member of the ASME, the ASCE, the Soc. of Am. Mil. Engineers, and the Soc. for Promotion of Engineering Education; and for five years he has represented Florida engineers in the Am. Engineering Council. Past-President of the Florida Engineering Society, he is now serving his ninth year as Secretary of that organization. Listed in "Who's Who in Engineering," Fineren is a recognized auhority on beach and shore-line preservation.

Johj Osterberg, who writes on soil mechanics, is now in resident study at Cornell for the degree of Doctor of Philosophy, which he hopes to receive in February. A native of New York City, he received his secondary education in the public schools there, and later enrolled in Columbia University, from which he was graduated in 1935 with the degree of Bachelor of Science, and in 1936 with the professional degree of Civil Engineer. Subsequent to pursuing graduate study in soil mechanics at Harvard under Dr. Casagrande, noted authority on that subject, he received the degree of Master of Science in 1937. Mr. Osterberg is a member of Theta Tau, Chi Epsilon, and is a junior member of the A. S. C. E.

William W. Cushing, of the class of '05, M. E., writes on the construction of the Lion's Gate Bridge—he is employed by the Hamilton Bridge Company, of Hamilton, Ontario, and was the supervising engineer on the Lion's Gate Bridge job.

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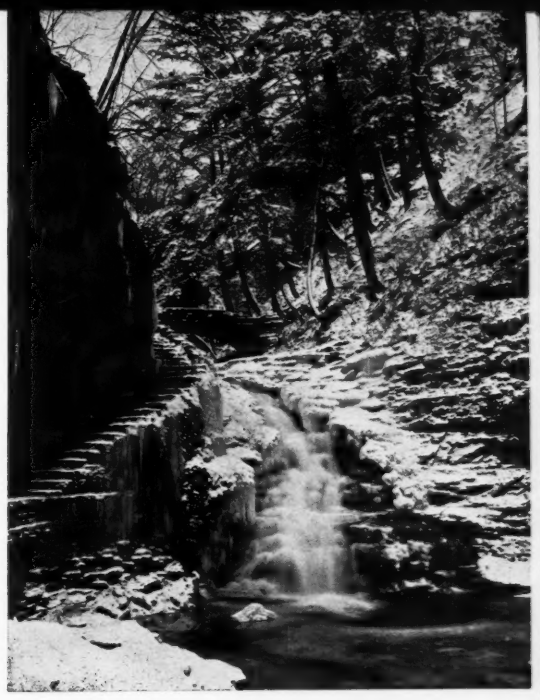

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Above is a cut of Cascadilla Gorge, which will soon reassume its winter dress.

●

OUR COVER

A recent picture of Rand Hall, which houses the machine shop, electrical laboratory, and wood shop. This is the only one of the present buildings which will become part of the new Engineering College when it is rebuilt. The building has recently had its face lifted, all of the exterior cement work having been replaced.

●

OUR FRONTIS

From Ingot to Rail. Courtesy of U. S. Steel News.

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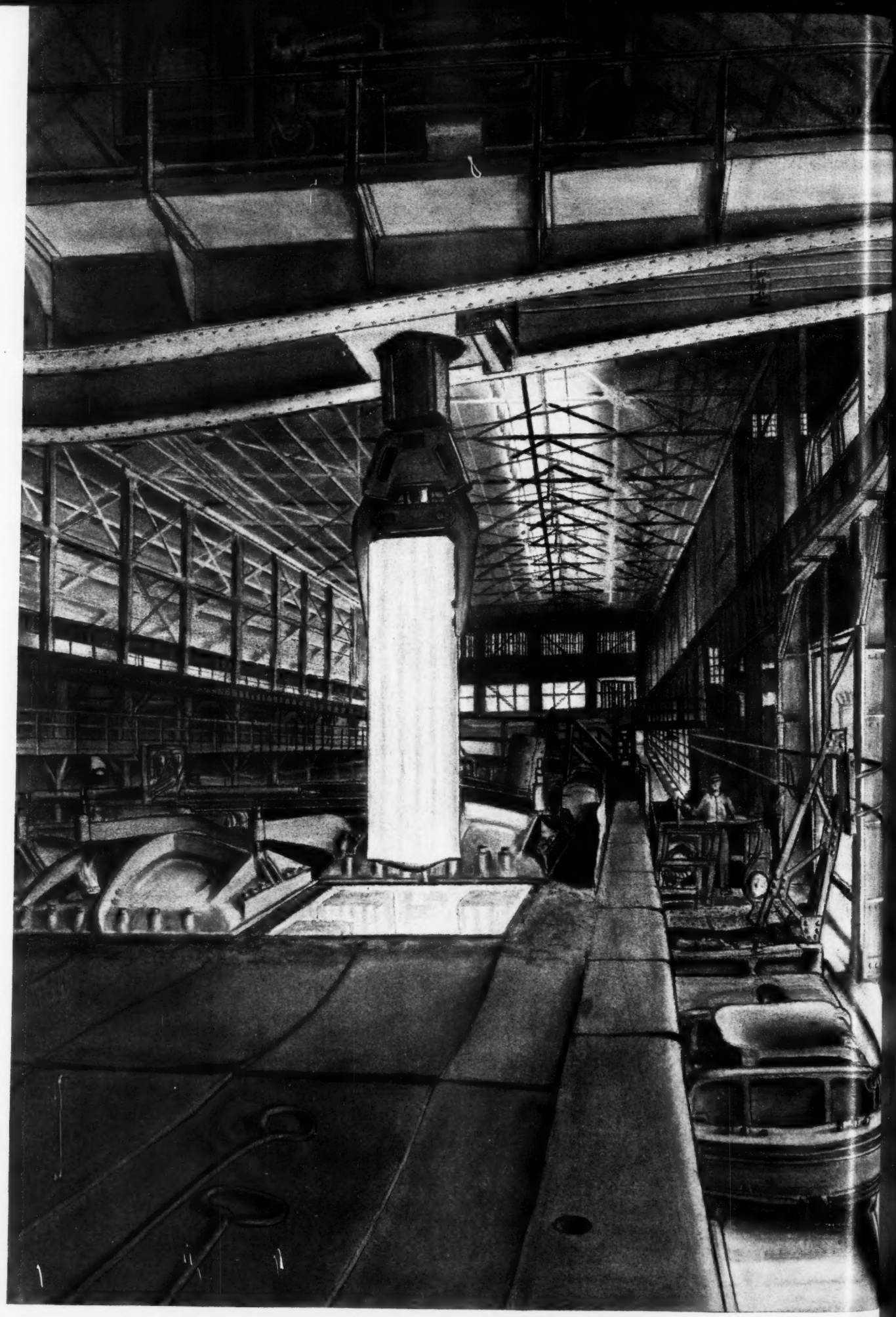


THE CONTRIBUTION OF THE ENGINEER

A Defense of the Machine

By WILLIAM WARRICK FINEREN, M.E. '02

The Source and Nature of Wealth

GOOD health, peace, happiness and wealth, are desired by all humanity. While the engineer has contributed, to a degree, to all these phases of life, his primary contribution to society has been in the field of wealth. Wealth does not consist of money. Money is merely a medium of exchange. Without materials, money would be superfluous. Wealth consists of the natural resources of a people and the tools by which these resources are obtained and prepared for use.

The world is full of good things to enjoy, but without tools man cannot secure them and without machinery cannot shape them for his own use. Take the diamond in the rough. Black as coal. You cannot wash it, neither can you pick it clear. No woman would wear a diamond that did not sparkle, and no man would be employed in the diamond trade. It takes the best grinding and polishing machines to bring out the lustre and make the diamond appealing. Thus do machines create desire, and desire creates work.

Without tools and machinery we would have no diamonds. Likewise, without tools and machinery we would have no coal, nor iron, nor steel. We would have no oil, kerosene, nor gasoline. We would be poor indeed, and everybody would be a tiller of the soil. Without tools we could not secure the things that nature has placed at our disposal. If we could secure them, we could not use them for lack of processing. We might plant the entire world to cotton, yet have no fine clothes to wear. No radios, moving pictures, nor telephones. Were it not for industrial machinery we would have very little canned goods and cheap package foods. The engineer may justly be proud of his achievement in making it possible for society to secure and enjoy countless thousands of good things that contribute to the wealth and happiness of mankind.

The Inspiration of the Engineer

The engineer has accepted the challenge of the Creator to search out the hidden secrets of earth relating to the "better things of life." In this challenge to Job, He says; "Where wast thou when I laid the foundations of the earth? Declare, if thou hast understanding. Who hath laid the measures thereof, if thou knowest? Or who hath stretched the line upon it?" The "declare if thou hast understanding" has challenged the engineers of all ages. The challenge may be taken as an invitation to investigate, subdue, and use the laws of nature for the benefit of mankind, which the engineer has done.

As to the "foundations of the earth," we know that bodies set in motion never stop unless hindered by some other force. As the earth swings onward through space (which is not an atmosphere), its circular motion around the sun continues without friction, in obedience to the law of its motion. Shooting stars are stars or small planets entering our own atmosphere, the friction of which causes the stars to heat to the burning point and throw off fiery sparks which look to us like tails, finally burning up and disappearing. But without friction, the earth never stops its onward march. So, we answer, the earth has none other foundation. "Who hath stretched the line upon it?" Not only has the engineer stretched the line all over the habitable globe, but scientists have measured the stars in their orbits and reached to the central sun and beyond.

Continuing the challenge, we quote: "Doth the hawk fly by thy wisdom?" Certainly not. But the airplane does. The mechanical hawk, if you please. Again: "Canst thou send lightnings, that they may go and say unto thee, Here we are?" Yes, we can. "Where is the way where light dwelleth, and as for darkness, where is the place thereof?" Engineers have harnessed electric energy. It was a momentous day to all the world when Benjamin Franklin led the lightning down his kite string, but it was not even considered "good news" when engineers succeeded in creating an electric flash of three million volts in the laboratory of their own making, leading it along paths of their own choosing.

"Doth The Hawk Fly By Thy Wisdom?"

If I may be permitted to continue with one more quotation from the Book of Job, let us consider the following: "Hast thou entered into the treasures of the snow? Or hast thou seen the treasures of the hail, which I have reserved against the time of trouble, against the day of battle and war?" We are yet able to answer, yes. Physicists have determined that water contracts while freezing to a certain minimum volume at a specific low degree, after which it again expands while continuing to freeze. The most compact and solid form of ice is that secured at a certain critical degree of cold. That is the secret of the hail. But what about the battle and the war? Just this—that every liquid has its own specific degree at which it solidifies into the most compact form. Engineers in the World War used this knowledge and concentrated their nitro-glycerine at the critical degree of cold for that substance, and compressed the largest quantity into the smallest space, creating the most destructive explosive known to science. The engineers who invented the process stated that they secured the idea directly from the passage of Scripture quoted. We use the term "critical degree of cold" as a popular term. Scientifically speaking, it is a degree of heat.

But, you say, what have these to do with mechanisms? Solving the problem of the earth's foundations gave us the toy gyroscopic spinning top of a few years ago. Today that top has become the stablizer of the greatest ocean liners, permitting them to keep even keel during the worst storms at sea to the comfort of the passengers. As the rotating earth cannot be swerved from its path, neither can the gyroscope be bent at an angle with its revolving plane. The measurement of the earth and the space between the stars has brought forth the telescope, transit, theodolite, level, and many other scientific instruments. The study of the birds of the air has given man his ideas of the flying machine. Experiments with lightning and the earth's magnetism led to the invention of the mariner's compass, telegraph, telephone, electric lighting and electric power machinery. The secrets of the snow and hail have not only produced refrigeration, but steam power machinery as well. The same water which freezes with such tremendous molecular force also evaporates into steam with equal power, if properly applied.

The Better Things of Life

Those of you who were fortunate enough to be able to attend the Century of Progress Exposition at Chicago in 1933 and see the Popular Mechanics Exhibit showing more than two hundred moving mechanisms of every conceivable form and motion were agreeably surprised to learn that so many forms of motion were common to mechanisms in everyday life. Here could be seen forward and backward moving pieces; up and down, sidewise and zigzag motions of rods and links; wheels within wheels, revolving and rotating fast and faster, slow and slower. These mechanisms make up the intricate machines of industry. We have in industry today the common small grinding wheels making 52,000 revolutions per minute of time, and, in the former Royal Palace of Potsdam, Germany, there is said to be a large clock wheel making only one revolution during 400 years of time. In between these extremes various mechanisms are humming various tunes. It is the use of such mechanisms as these that makes life so easy and pleasant today. At the push of a mere button, or operation of some simple device, all the comforts of the modern home are brought into play.

In speaking over the radio I used the illustration of the wheel that made only one revolution every 400 years. Later I was asked if it could be the truth. It seems incredible to some people that such could be a fact, but it should be remembered that 400 years of time totals only 210,240,000 minutes, not counting quarter days and leap years. In the ordinary eight-day household clock there are only four sets of gears (which we call a train of gears) between the second hand and the wheel which turns every twelve hours. This is a reduction of one to 43,000 by only four small wheel pairs. If we had eight small wheel pairs of about the same proportion, in place of four, this reduction would be as one to 1,866,240,000. Take, for instance, an eight-pair set of gears with each of the smaller gears having eight teeth and each of the larger gears having eighty-eight teeth. If the first small gear turned around once in one minute, the last gear would turn around only once in 214,358,881 minutes, which is 4,118,881 minutes more than 400 years. If we compare the grinding wheel making 52,000 revolutions during each minute to the clock wheel making

only one revolution during 400 years, we will see that the one wheel moves 11 trillion, 146 billion, 661 million, 812 thousand times faster than the other.

A hundred years ago—yea, less than fifty years ago—men who used mechanisms were specialists in their line. Today, the ordinary housewife has become efficient in the operation of machinery of varying degrees of complexity. The wrist watch, time clock, gas and water meters; the electric fan, toaster, curling iron and pressing iron; the piano, victrola, radio and mechanical refrigerator; the circulating heater, washing machine, sewing machine and carpet sweeper; the vacuum cleaner, telephone, weighing scales and typewriter; the pressure gauge, combination lock, fountain pen and safety pin; the flush tank, hose sprinkler, lawn mower and windmill; the hand pump, ice cream freezer, can opener, and coffee mill; the sausage grinder, flour sifter, egg beater and mouse trap; roller skates, papa's safety razor, mamma's perfume atomizer, and little Sarah's doll that talks; all these—and more—have caused the housewife to take a deep and vital interest in things mechanical and scientific, not to mention the automobile, motor boat, airplane, bicycle, and velocipede, and little Johnnie's innumerable mechanical toys.

Abolition of Slave Labor

During the building of the Great Pyramid of Gizeh in Egypt about 2170 B.C., it took 100,000 men all of thirty years to place the six million tons of stone one above the other. It would take six thousand steam engines to move this stone, each engine hauling one thousand tons at one load. How was this work accomplished? First, it took ten years to construct a mountain of sand with very gentle and easily navigated slopes up which the huge blocks were dragged by slave labor. After the work was completed, the mountain of sand and earth was entirely removed. That was the slave age. Work was provided for 100,000 men for thirty years, a most commendable project. But it was slave labor. Imagine a few powerful steam engine derricks, with a hundred men, doing in a year's time what it took 100,000 men thirty years to accomplish.

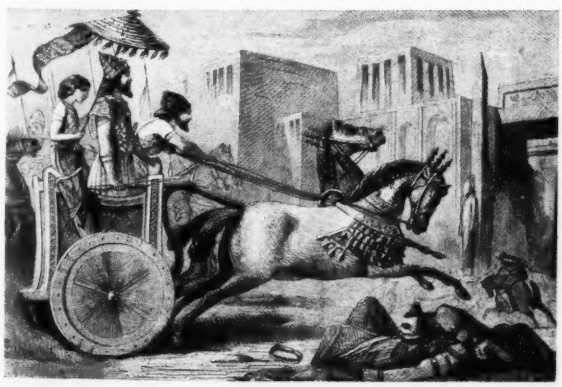
The Great Wall of China is another illustration of slave labor. The wall is 25 feet wide at the base, 15 feet wide at the top, and is from 15 to 30 feet high. It is 1,500 miles long, as long as from New York City to the Colorado State line, and is stated to have taken one hundred years to construct. The large stones were placed one above the other by the same method used in the pyramids; that is, by constructing earth slopes, dragging the stones up the slopes, and then removing the earth.

Machines are used for the very purpose of destroying this slave labor. To the engineer must go this credit.

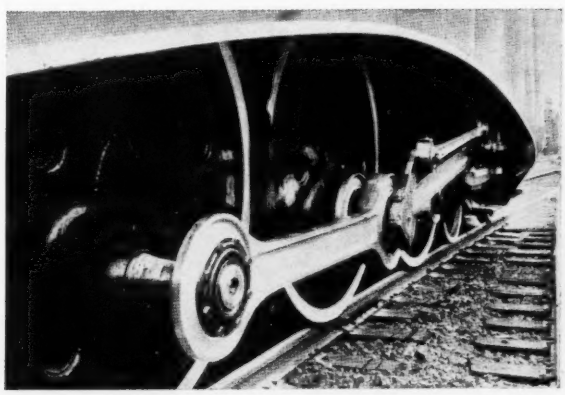
Every high-school pupil has become familiar with the galley-slave days of ancient history. Here, men were chained to the oars, four each to one oar, and their main business in life was to tug at the oar without ceasing, there being fifty-four oars and two hundred and sixteen slaves to the galley. Who, among those who cry out against the machine, wishes to return to these slave-labor days, with no ambition in life?

The Machine Creates Desire

If the farmer is forced to abandon the modern harvester, teeming millions of people may be forced to do without sufficient wheat for their daily bread. In the same way, the abandonment of the modern tractor will ruin the cotton planter in the South and West. If the highly intricate mechanisms in the modern printing press are cast aside in favor of hand printing, many of our bulky and questionable Sunday supplements will not be available to the public. At the Century of Progress Exposition they exhibited machinery which manufactured cereal boxes as fast as one could count. How many of you would prefer the old hand-method of box making at a cost of twice what you now pay for your daily breakfast food?



King Priam Entering Troy
(Note the crude wheel)



Modern Roller Bearing Railroad Wheels
(Product of the machine age)

The stock yards pack your lard and other such products by machines which are almost human in their accuracy and rapidity, and even more than human in their cleanliness and sanitation. How many of you would prefer the old and unsanitary human-finger method of molding and packing your lard and butter, and, at the same time, pay a higher cost for the product on your dinner tables?

What woman would go back to the old days of the lone shoe cobbler, or the old spinning wheel, after tasting the delights of fine machine-made footwear and many-colored silk stockings?

Desire Creates Demand

Here is a side of the question which has not always been given consideration. Suppose we had never seen a steam engine nor an automobile. We could not conveniently travel. No cars would be manufactured, no ores mined, no coal burned, no steel manufactured, no oils and gasoline produced, no depots erected, no tickets sold. What would all of the millions of people engaged in the trades connected with these things be doing for a living? Suppose the telephone and telegraph had never been invented. We would not have created the extravagant habit of talking too much, and nearly half a million persons would be looking for work in other fields. Suppose we had never seen a radio or a moving picture machine. Well, we certainly do not need them. We can live without them. But if we were living without them, what would the 384,000 workers in these lines be doing for a living? We might possibly get along without modern refrigeration, but would that add the 72,000 men engaged therein to the ice wagons? What chance is there for any laborer making things which we do not want? If we do not increase our demands and wants in proportion to the growth of the population, what will the extra population do?

The automobile, airplane, telephone, telegraph, radio, refrigerator, electrical generator, and other intricate machinery, have given us something new—something we didn't have before. We do not need them, *but we like them. We want more of them,* and our wants are increasing. Desire creates demand and demand creates labor. Not counting railroad labor, at least 6,500,000 persons have been employed at living wages to gratify our wishes for things which we could easily do without. That does not easily prove that the machine is destroying labor. The following figures were taken from statistics secured by the Museum of Science and Industry of New York, to wit: 17.1 per cent of our entire steel industry, 43.0 per cent of our plate glass, 53.0 per cent of our leather, and 80.4 per cent of all our rubber goes into automobiles. To stop making automobiles would be suicidal.

The Machine and the Fuller Life

While people are blaming the machine for all of our ills, let me suggest that possibly the machine is not quite entirely to blame. Changing styles and habits of life have done as much as the machine in reducing employment and destroying personal and property values. For instance, the short-skirt fad threw consternation into the lives of many a cloth manufacturer. The wide-spread use of rayon fabric almost ruined the silk industry. The bobbed-hair fad put a stop to the manufacture of hair switches for the ladies. The idea of the men going bareheaded interfered with the men's hat industry, and college boys put a crimp into garter manufacture. And what the younger generation of athletic-aspiring women did to the manufacturers of corsets is a matter too well known for further discussion.

The progress of civilization has not kept pace with the advancement of the machine. The world has failed to advance fast enough to grasp the advantages of the machine age and adjust itself to the conditions of the age. The public must be educated up to the machine. Education is vital not only in civic, cultural, and social matters, but in humane, unselfish and spiritual endeavor. The machine must not be used for selfish greed and gain. The careless autoist speeding through crowded highways is promptly arrested for violating the rights of others. He is immediately made to understand that other people have some right to live. In the same way, the manufacturer who is fortunate enough to possess modern machinery of the highest quality must not be permitted uncontrolled operation of that machine to the detriment of the human beings who depend upon that particular trade or occupation for a livelihood. He must also be made to understand that other people have certain definite rights to live. It is not at all out of place to suggest here the Golden Rule among men in dealing with the problem of "the human versus the machine." If this is done there will indeed be peace and prosperity in the earth, slave labor will be a thing of the past, and no one will ever have cause to criticize the machine. Think of the hundreds of little toys in the home which are mechanisms that move and act and talk. Think of the hundreds of useful things about the house that make life a pleasure and without which it would be almost impossible to live in this day and age—which things are only available because of the perfection of the machine. And then ask yourself if it is not possible to educate ourselves up to the proper use of these mechanisms (from the talking doll to the thinking robot), so that while we enjoy their uses, those who make them may, at the same time, secure enjoyment and prosperity in their labor in the making of them. The engineer has this task before him, to consolidate and reconcile his contributions to humanity. The machine has given rise to the "fuller life." The engineer has created the machine.

EARLY GLIDING AT CORNELL

Today's Flying Activities on the Campus Bring to Mind Early Experiments with Gliders

By RUTH DYNES, E.E. '42

Gliding is a sport which has attracted enthusiasts in geometric progression during the past ten years. The thrill of a silent, sweeping descent through the air without visible motive power has been re-discovered by thousands since 1930, but the fact has been obscured that gliding ante-dated the development of airplane flight, and that by it, the laws of aerodynamics were explored.

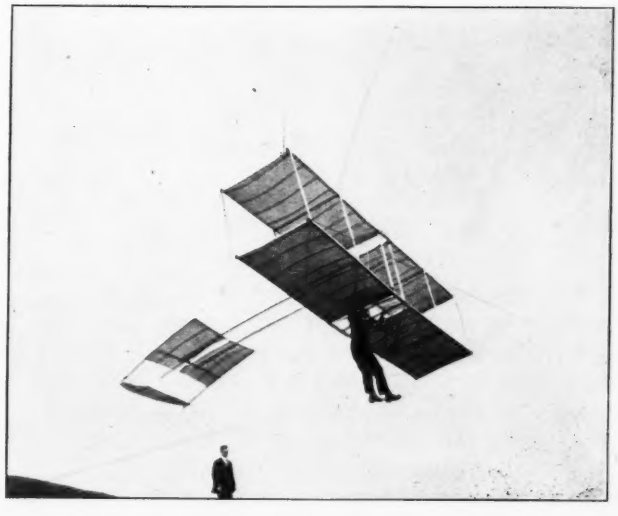
Equally forgotten is the fact that Cornell students, in a wave of interest following the first experiments in aviation, organized a Cornell Aero Club in the fall of 1909, "to promote the investigation and study from a theoretical and practical standpoint, of the science of Aeronautics." The primary objective of the eighty odd members was to fly a powered plane, but the expense was so great that half the club turned its interest to gliders during the first year. The faculty of Sibley College, in the face of this sudden air-consciousness of the student body, agreed to initiate a course of Aerial Engineering in the first term of 1910-1911, but the members in the meantime embarked on a program of self-education, students who knew something of theory acting as instructors for the others.

The course in "Glider Construction and Manipulation" was managed as though it were being given in the University, staffed by a Head-Instructor, three Instructors, each in charge of a section, and under them, eight assistants. Each of the sections, which met six times a month, was responsible for designing and constructing a glider, their plans to be passed on by an Engineering Committee of three students.

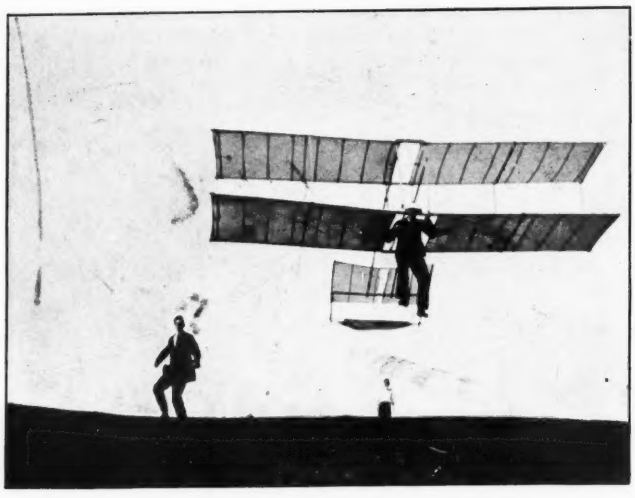
The students who banded together were studying a field new not only to themselves but to scientists and engineers. Gliding today is a safe sport, but at that time it was entirely experimental, and as a result, dangerous. Just twenty-five years earlier, in 1884, Professor John J. Montgomery of California made the first successful flight in a glider. He went a distance of 600 feet, borne by a forty-pound monoplane patterned after a sea-gull, with wings that arched downward and an area of ninety square feet. Towed by his brother in the face of a ten mile breeze, Montgomery succeeded in rising off the ground and going over his brother's head. He was injured in 1904, and until his death in 1911, was forced mainly to direct others in flying his craft. To accumulate the money he needed for research, Montgomery trained adventurous cowboys of the neighboring country to stunt his ships at exhibitions. One of his pilots remained aloft twenty minutes and flew eight miles.

Next, and most famous of the four pioneers in motorless flight, was Otto Lilienthal. This great German was the first to make a soaring flight. Soaring differs from gliding in that the sailplane may attain an altitude higher than that from which it began, by taking advantage of the up-sweep of air-currents on the windward side of hills, mountains, and sand dunes, under cumulus clouds, or above fields which are radiating the heat of the sun. Flying over water, dark fields, and woods in the daytime adds to the downward force of gravity. The Montgomery gliders attained their high initial altitude by being lifted by balloons, and then cut loose.

Lilienthal conjectured on means of flying all his life, and made his first successful leap when he was forty-three, having made a reputation for himself as an engineer and manufacturer. His glider was a simple framework of willow rods covered with cotton



One Of Cornell's First Successful Gliders In Flight



Take Off From Kite Hill

cloth, with an area of 100 square feet. This came to be called the "hang" type of glider, in which the pilot suspended himself, feet dangling, by leaning on arm rests usually lower than the wings. By swinging his legs, an experimenter counterbalanced the effects of gusts of wind. Between 1891 and 1896 Lilienthal made two thousand flights, a few covering a thousand feet and lasting more than a minute. His maximum estimated speed was twenty-two miles an hour. He built a biplane and soon found that it had greater stability and a better gliding angle, which permitted longer flights. On the eve of trying out a new glider, which he had equipped with a motor, he made a flight in this plane, and when it stalled, failed to regain control of the ship, dying as a result of the crash.

Percy S. Pilcher, an English sailor, was the first to make a towed glider flight. Instead of running into the wind, until the velocity of the wind past the wings gave them sufficient lift, Pilcher hitched his plane to a team of horses, which was driven across a field. It rose, somewhat like a kite, and travelled 800 feet. Like Lilienthal, he was killed just before trying out a motor-powered plane.

Octave Chanute, a Frenchman who lived in the United States, became interested in gliding when he was sixty. After trying the Lilienthal-type monoplane, Chanute tested multi-winged ships. Athletic ability was required to manage early gliders, and Chanute sought means of mechanical control which would compensate for his age. He finally devised a bi-plane more stable than anything that had been built, which could stand speeds of over fifty miles an hour, using a truss framework between the wings, derived from his work with bridges. Chanute never experimented with motor flight, which was probably prudent considering his health.

The Wright Brothers began constructing gliders at the turn of the century, and by 1902 were proficient in flying them. They were the first to abandon body-control, patenting a combination of warped-wing and rudder action.

As a result of this series of investigations, it had been discovered that longitudinal control, or pitching, could be attained by the use of elevators; that directional control, or yaw, was effected by the use of a rudder; and that lateral control, or rolling, could be minimized by the use of ailerons. It was known that unnecessary wires and struts added parasitic drag, resistance not caused by the wings, and that streamlining permitted a larger cross-section of fuselage. The principle of lift-drag had been elaborated, that is, that the ratio of lifting force on the wings and the resistance caused by impact with the air, depended on the angle of incidence, or the angle which the wing made with the axis of flight.

With this background of simple theory, the club's members designed five gliders in all, supplementing what they could learn from the available textbooks by studying wooden models, or even paper gliders.

During the year 1909-1910, two privately-owned gliders of the Chanute body-control type, were loaned to the club, and subsequently wrecked because of the inexperience of the students and the lack of inherent stability and manageability of the ships. The members set about building their own ships, and in April, 1911, Glider No. 1 was finished, its plans having been altered as the work proceeded. The result was a biplane of thirty-foot span, a lifting surface of 300 square feet, which weighed 143 pounds. For lateral control, it had four ailerons hinged to the edge of the wing tips, for longitudinal control, a non-lifting tail nine by three feet.

While this ship was under construction, a "teacher" was being built on the lines of a model used in France. A skeleton framework was mounted above the ground on a universal joint which permitted motion in any direction. This dummy flyer was fitted with the same controls as would be used by a student in flight, including the rudder bar for directional control and the stick for longitudinal control. Besides teaching the use of these, the trainer gave a prospective flyer experience in balancing himself while in the air. Balancing was considered so important that inter-section balancing meets were held to encourage proficiency along this line. During 1910-1911, a second teacher was built which was an improvement over the copied model.

Following this preliminary work, the members made towed flights on level ground, in which they picked up the knack of longitudinal and lateral balance. Towed flights down slopes followed, and finally free gliding was attempted, some of the field work taking place on Kite Hill behind the stadium.

(*Continued on page* 31)

THE LION'S GATE BRIDGE

A Description of the Bridge Spanning The Entrance to Vancouver Harbour

By **WILLIAM W. CUSHING, '05 M.E.**

THE Lion's Gate Bridge spans the First Narrows of Burrard Inlet at the entrance to Vancouver Harbour and affords direct communication from Stanley Park to West Vancouver, on the North shore. The entrance to the harbour is known as the "Lion's Gate", and is so named from the fact that two mountain peaks on the North Shore bear a very strong resemblance to the crouching lions on the Nelson Memorial in Trafalgar Square.

The structure consists of a main suspension span of 1150 feet, center to center, of towers and two side suspension spans of 614 feet each, as well as a steel viaduct approach of 2196 feet. The clearance over extreme highwater is 200 feet for a width of 200 feet at the centerline of the main span.

It is hard to find a more ideal setting for a structure of this kind from a scenic point of view, having the City of Vancouver on one side and the mountains of the Pacific Coast Range on the other with the wide expanse of the Gulf of Georgia to the west, and the towering snow-covered peak of Mount Baker in the State of Washington showing above the clouds.

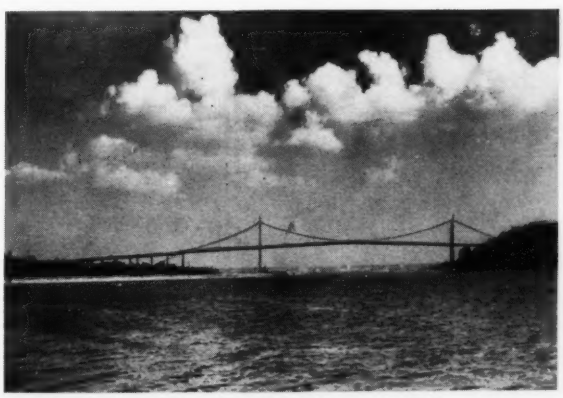
The bridge was primarily built to serve what is known as the "British Properties", which is a residential development situated on the slopes of the mountains on the North Shore. The south end of the bridge is reached by a winding drive through Stanley Park with no grade intersections, and the North end intersects the main highway on the North Shore and has an overhead crossing with a cloverleaf intersection.

The structure was designed by Messrs. Monsarrat and Pratley, Consulting Engineers, Montreal. Associate Engineer was Major W. D. Swan, Consulting Engineer, Vancouver, B. C. They started working on the job in 1928 and made various designs using different lengths of span up to 1800 feet, and different widths and weights of roadway, before the design of the structure as built was finally decided upon. In all these preliminary designs, the major problem was always the anchorages.

The contract for the superstructure was a joint one between the Hamilton Bridge Company and the Dominion Bridge Company; the Hamilton Bridge Company having the fabrication of the North viaduct, all of the stringers on the suspended spans and the floor beams on the side spans; the Dominion Bridge Company having the fabrication of the remainder of the steel. The erection was carried out by the forces of the Dominion Bridge Company acting as agent for the partnership.

The main towers are 364 feet from the top of the pier to the cable intersection, the tops of the piers being about 8 feet above extreme highwater. The north cable bent is 166 feet from the top of the pier to the cable intersection and the north approach is on a grade of 4.836 percent. The bases of the towers are 69 feet 9½ inches, center to center, and the cables are 40 feet, center to center. The width of the roadway is 29 feet between curbs with two four-foot sidewalks. The clearance from the crown of the road to the under side of the tower portals is 42 feet. At present the bridge deck is marked for two traffic lanes. The toll houses are located on the fill at the north end of the viaduct.

The first portion of the structure to be erected was the North viaduct, as the piers were ready before the main tower piers were completed. Practically all the steel for the entire structure was loaded on scows at



The Lion's Gate Bridge

the Hamilton Bridge Company wharf at False Creek, and was towed to the bridge site. A wharf was built on the North Shore of the Narrows and shipments were so arranged that the scows would arrive at high tide and be moored over a timber grid supported on piles on which the barge would rest at low tide while the steel was being unloaded for use on the north viaduct.

Erection of the South main tower was started on February 2, 1938. Originally it was intended to proceed simultaneously with both the North and South towers, but as the south piers were completed considerably in advance of the north piers, it was considered advisable to proceed at once with the erection of the South tower, and thus avoid duplication of erection equipment.

Each tower leg consisted of 9 sections, exclusive of the base, and one complete tower including bases and saddles weighed approximately 1000 tons. The material for the towers was shipped on scows and placed directly in position with no intermediate handling, the erection being carried out by a creeper traveler. The creeper was located on the shore side of the tower and it carried a stiff-leg derrick with a 30 foot mast and a 69 foot boom having a capacity of 21 tons on a radius of 50 feet. As the tower legs varied in size and were battered, the creeper had to be adjusted as it progressed up the tower.

The lengths of the tower sections vary, the bottom section being 23 feet long, the remainder being an average of 40 feet long with one exception.

Great care was taken before starting the erection to locate accurately the shoes on the piers. The center lines of the shoes were scribed on four sides of same and corresponding marks were made on the tops of the piers and very carefully checked. The tops of the piers had been hammer dressed and oil-soaked canvas was placed between the shoes and masonry. Every precaution was taken to maintain perfect contact between the faced joints of the tower posts during erection. The core (interior) sections were erected first and the splices securely pinned and bolted to prevent any disturbance of the joint while the wing (outside) sections and other members were being erected. The bearing angles on the wing sections were brought to bear and their splices secured by pins and bolts before the connections were made to the core sections. The splices at both ends of each post section were fully riveted before the rivets connecting the core and wing sections were driven.

Due to the fact that camber was provided for in the tower legs, that is about $\frac{1}{8}$ inch was added to the theoretical length of each section to allow for compression under load, $\frac{3}{4}$ inch diameter erection bolts were used in bolting up the bracing connection, the holes being 15/16th inch in diameter. Some slight drifting was necessary for cross tackle used to bring the rivet holes fair after the main post splices were riveted. The erection of the North tower varied somewhat from that of the South tower as the ground was above highwater. This eliminated the necessity of the steel platform, for erecting the creeper traveller, and timber falsework was used for this purpose. Each tower required about 45,000 field rivets.

The South cable bents were trucked in and erected with a guy derrick. These bents were about 11 feet long and weighed approximately 6 tons each. The bents had forked ends supported on pins. There were platforms at the tops of the bents to support the catwalk cables.

As soon as the towers and cable bents were completed, temporary suspended walkways, commonly called catwalks, were erected for the entire distance between the North and South anchorage piers. Their purpose was primarily to provide a platform for the hauling and adjustment of the main cable strands and also for the erection of the cable bands, suspenders, and stiffening trusses. The catwalks were 6 feet wide and were made of clear spruce planks in sections 10 feet long, each catwalk being supported by two 1-1/16 inch and two 1-$\frac{3}{8}$ inch cables. Grooves were provided on the underside of the catwalk sections to fit over the cables and hooked bolts were used to secure the catwalk sections to the cables.

The catwalk cables were in two lengths, one reaching from the south anchorage pier to a point just in front of the north tower and one from this point to the north anchorage, the joining ends being socketed to a forging and the connection being made by a pin.

The short cables for the north side were delivered by truck, the ends attached to the north anchorage, the east side reels placed on a buggy on the service track and laid out with their ends hanging down over the edge of the north tower piers; and on the west side they were unreeled from a truck. The long cables for the main and south side spans were mounted on a scow moored in front of the south tower piers. A cable was used to haul the ends of the cables from the scow to the south anchorage; then the scow was towed across the channel and the cables hoisted into position.

The catwalk sections were next erected; on the north backstay by means of a line running from a snatch block on top of the north approach; on the south backstay by means of the guy derrick on the south anchorage; and the remainder of the sections were hoisted to the tops of the towers, laid on the cables in grooves provided on their under side and allowed to slide as far as they would from their own weight, after which they were pulled into position. Cross timbers were placed at intervals between catwalks, and a light bridge was placed in the center of the main span for access from one side to the other.

A$\frac{1}{2}$ inch cable was strung on vertical posts to act as a handrail. Cross frames were placed at intervals

(*Continued on page* 28)

SETTLEMENT OF SOILS

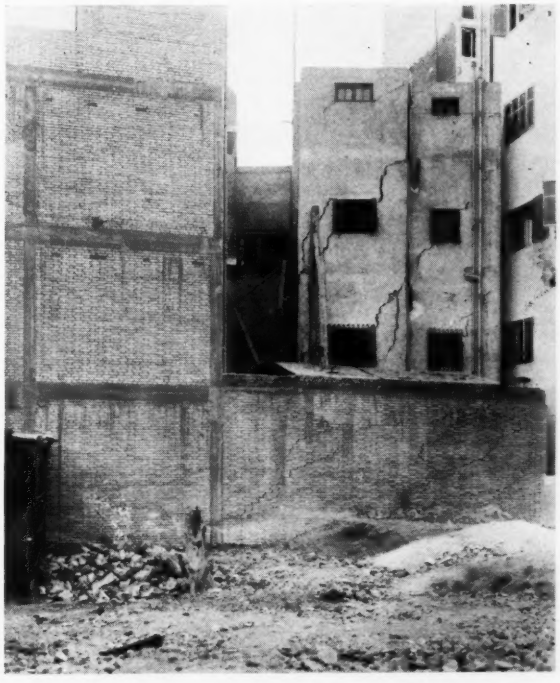
A Discussion of the Problems Arising From the Settlement of Foundations

By JOHJ OSTERBERG,
Graduate Student in C.E.

The engineer has always been confronted with troubles from settlement of structures on soil foundations, but until recently, he could do nothing about it. Today, due to the principles of the consolidation theory of clay, settlements can be predicted with some degree of accuracy and structures can be designed more rationally to avoid detrimental settlements. Structures of steel and concrete, being of homogeneous uniform material can be computed and designed with considerable refinement. Soil foundations cannot be designed with such accuracy or detail because of the large number of unknowns in the problem and the variable character of the soil itself. But with good sound theory combined with practical experience and some ordinary common sense, soil mechanics can be applied by a foundation engineer to obtain a more rational and safer design. Each foundation problem must be considered separately for there are never two soils exactly alike. Careful and thorough borings must be made to fully explore the underground. With such an approach as this, rather than by blindly applying a theory without carefully considering its assumptions and limitations, adequate foundations can be built on the most unfavorable ground.

All structures ranging from the Empire State Building built on solid bed rock to the shack in a swamp, must settle. We don't have to worry about buildings on sound rock because the elastic compression caused by the load is small, and the strength of the rock is far greater than the load imposed upon it. But buildings on soil are another question, for the settlements may be so large that the buildings themselves crack and fail by the excessive bending moments produced. The most important question is not so much the amount of total settlement that will occur but more the differential settlement. If a building settles uniformly it merely stands at a lower elevation, but if the inside settles six inches more than the outside, the building may collapse. No one can design a building resting on soil that will not settle at all, but structures and foundations can be designed so that the differential settlement is not large enough to cause damage.

How much do structures settle? The Washington Monument has perhaps the longest settlement record of any structure. This monument is of such immense weight and height, that to avoid extreme settlements and tilting it could only be built where the soil conditions were favorable. The underlying soil is mostly compacted sands and gravels eighty feet thick, overlying bedrock, with a thin layer of clay in between. Nevertheless, the load of five tons per square foot on the foundation due to the weight of the monument has caused a settlement of six inches since construction began in 1870. Only one and one-half inches of settlement has occured since the structure was com-



Result Of Excessive Differential Settlement

pleted. Fortunately the settlement has been uniform and the monument is very nearly plumb.

Contrast this with the National Theatre building in Mexico City which has settled five feet in the center, the differential settlement being so large that you can see the sag in the horizontal lines of the building. This building which was built mostly of stone is flexible enough to take the bending, so that it does not collapse.

This structure built on clay is an extreme case, but many other structures built on compressible soil show considerable settlement. A post office in Austria settled two feet in twenty years due to a soft clay layer only fifteen feet thick. Buildings in Boston, Cleveland, Chicago, and Detroit must be built on clay and must be designed to take a certain differential settlement. In fact, the height of buildings in these cities is limited because of foundation conditions.

Settlement, of course, is due to compression of the underlying soil. In sands and gravels the settlement is small and much of it is elastic compression. In clays, however, the compression is due mostly to consolidation and a small amount of plastic flow. There is little elastic compression. Consolidation is the process of reducing the voids or open space between the clay particles by squeezing out part of the contained water. Since clay consists of very fine particles and the open spaces are extremely small, it takes a long time to squeeze the water out, and therefore it takes long for it to consolidate under a load and come to rest. Computations on the time of settlement have revealed that in some cases it may take hundreds of years for a clay to fully consolidate under a building.

Suppose we have a building as shown in Fig. 1 and we want to know how much it will settle after a given number of years. The complete procedure necessary to find this out is very long and complicated but a brief outline of it can be given. Before anything else is done, complete borings must be made to fully explore the underground and undisturbed samples of clay taken for laboratory tests. We will consider that we want to know how much point A will ultimately settle and we have samples taken every ten feet along boring AA. A sample of clay about an inch thick and four inches in diameter is placed in a consolidation device. This is nothing more than a cylinder which holds the clay between two porous stones allowing free drainage in a vertical direction and upon which loads may be applied. An increment of load is put on this device and the settlement and time recorded. When the sample has fully consolidated under this load another increment is added. By plotting the loads and settlements a curve such as shown in Fig. 2. is obtained. The curve bends over to a straight line at a pressure called the pre-consolidation load. This is the load under which the clay has been consolidated due to the weight of the soil above, before it was tested.

Now suppose the weight of the structure produces a pressure distribution along line AA^1 in the foundation as shown to the right of Fig. 1. In the first ten feet we have an average pressure $\triangle p_1$ due to the building. The pressure that existed there before due to the weight of the soil above was p_1. Therefore on the curve of Fig. 2 we increase the pressure p_1 by $\triangle p_1$, we have a corresponding settlement $\triangle s$. If we multiply this by the ratio of the thickness of the layer we are considering to the sample thickness, that will give us the total settlement of this layer. By doing this for all the layers, we find the settlements of each and by adding them the total settlement of point A is obtained. The settlement of point B is calculated similarly.

We know from the consolidation theory that the time for complete consolidation for any given clay varies as the square of the thickness. Therefore if it takes two hours for a sample one inch thick to fully consolidate, it will take the sixty foot layer about 120 years to consolidate completely. Most of the time we are not interested in knowing what is going to happen in a hundred years; we want to know what will happen after one, five, or ten years. In order to find what percentage of the total settlement will occur in any given time complicated formulas from the consolidation theory are applied, using the soil constants determined from the tests. It is then possible to plot a curve such as shown in Fig. 3, giving the settlement of various points of the structure at any time.

Though this theory involves many assumptions we know are not exactly true, the results obtained are fairly close to the measured settlements. Generally the computed values are a little higher than those observed.

The most peculiar type of soil for foundations is found in Mexico City, where extreme difficulties were experienced from settlements. The city lies in a large basin area of extinct volcanos, surrounded by high mountains on all sides. This basin has been filled to large depths with fine volcanic ash that has been blown into the valley from active volcanos and deposited by settling through the water of a large prehistoric lake that filled the basin. The fine volcanic debris coagulated out of suspension forming a very loose spongy flocculent structure. This peculiar jelly-like subsoil of the city is highly compressible and contains over 300% water content (i. e. three times as much water as solids by weight) and can be said to be a jel from a chemical view point. Since this particular material is over 300 feet thick at Mexico City, it is impossible to go through this material to more stable ground underneath or farther down than that to rock.

Engineers are then compelled to build on this undesirable highly compressive clay. Many curious experiences have occurred in constructing foundations. The soil is so sensitive to load changes, that small fluctuations of ground water level cause settlement and expansion of the ground surface over wide areas (a drop in water level will increase the weight of soil due to lack of buoyancy, causing settlement and vice versa).

In the case of the Lottery Building, designed to have seventeen stories, there was an uplift of more than four feet when the old buildings on the area were removed and the earth excavated. The excavation had to be loaded down with ballast equal to the weight of the proposed building in order to bring the ground level down to near where it was, and then as the building was erected the ballast was gradually removed. In other cases, buildings have settled even though the weight of the building is less than the weight of the soil excavated. This occurs because in excavating, the soil expanded and then when the load of the building was exerted on the soil, it settled again. Even if a foundation is ballasted so that at all times the weight of the soil removed is counterbalanced with ballast and if the final building has the same weight as the soil excavated, settlements are still noticed. This occurs because the distribution of the load is not the same as before, because there is a drying out of the clay during excavation, and also because of changes in ground water levels.

The above fortunately is only a very extreme case of the troubles one gets into building structures on clay foundations. Clays generally do not "rebound" or swell as much as Mexico City clay, nor have as high compressibility. Nevertheless all foundations on clay take considerable investigation, care on design, and experience, to be successfully constructed.

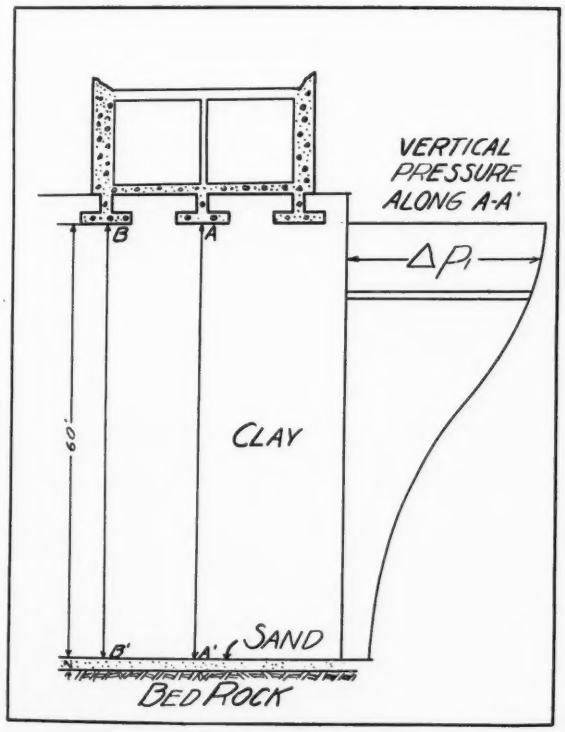
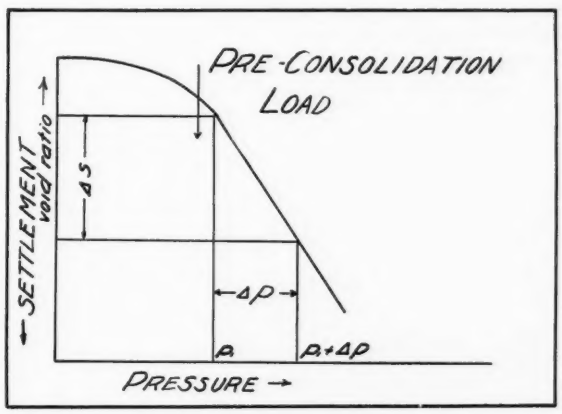
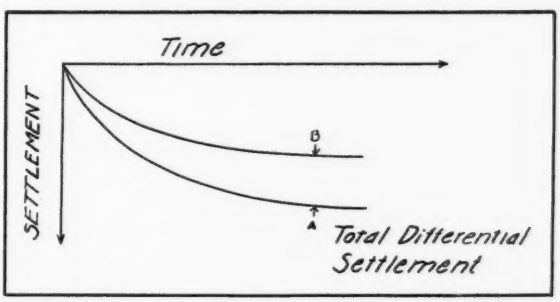


Figure 1





Figures 2 and 3

Loading an Electric Air Furnace Designed for Heat-treating Aluminum-alloy Sheet-metal Parts

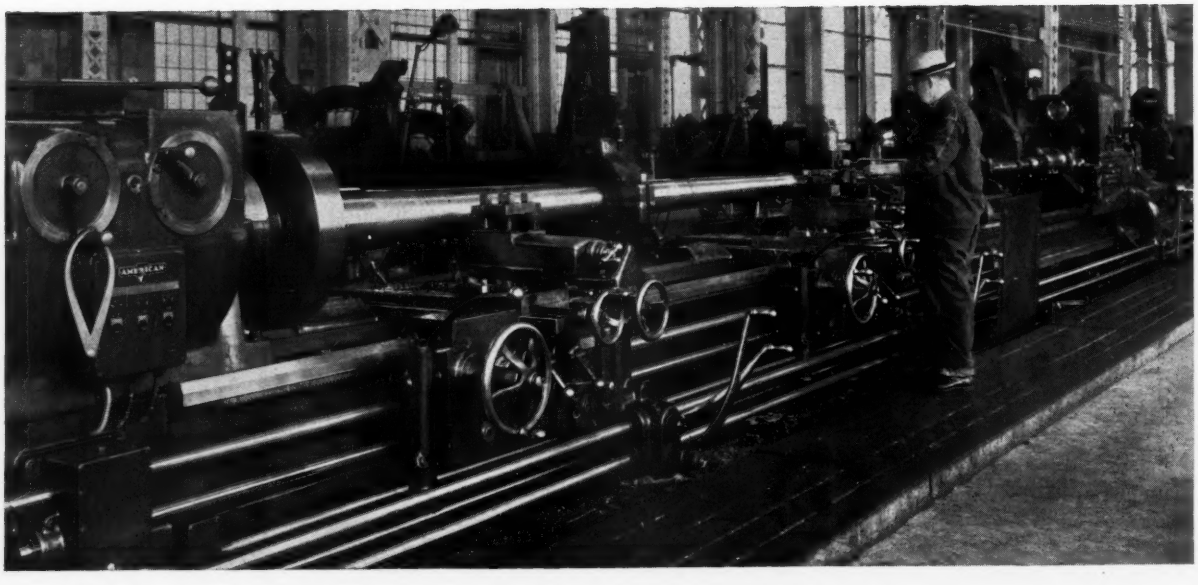
BACKBON O

Scenes From Indust

There has been much written and spoken lately about the background of war. The eternal question of why men cannot live in peace has been raised again and again, and remains unanswered.

Now that hostilities are well under way, men turn their thoughts to the backbone of war, the production of the machines and chemicals which make possible the efficient mass slaughter of our age.

One of the few things which can be said of the munitions maker is that his products represent the best in quality and skill which can be produced, regardless of expense. Each nation as it goes to war diverts its most skilled mechanics, its greatest technical minds, its precision machines, and the most precious of its raw materials from the production of the goods which make for better living to the making of the machines for quicker dying.

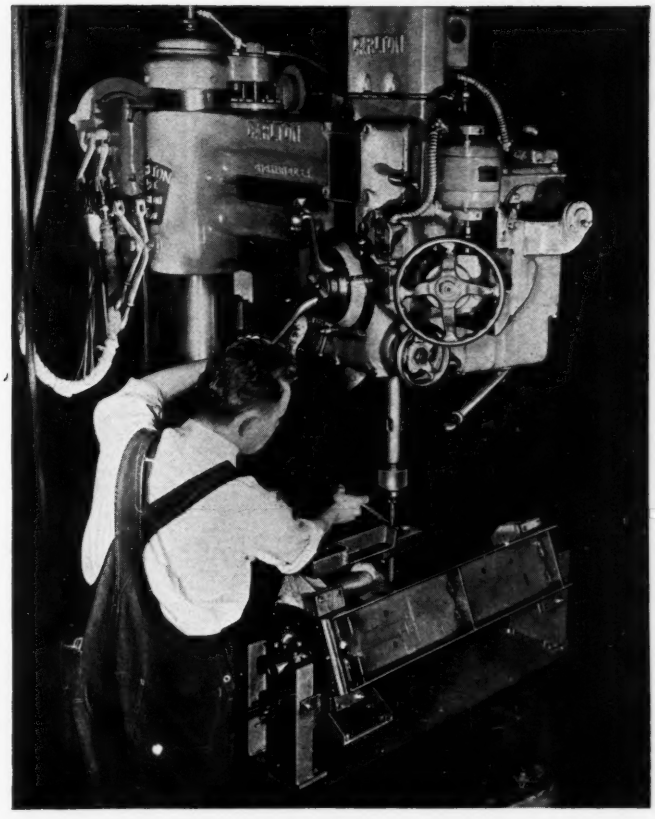


OF WAR

Industrial Front

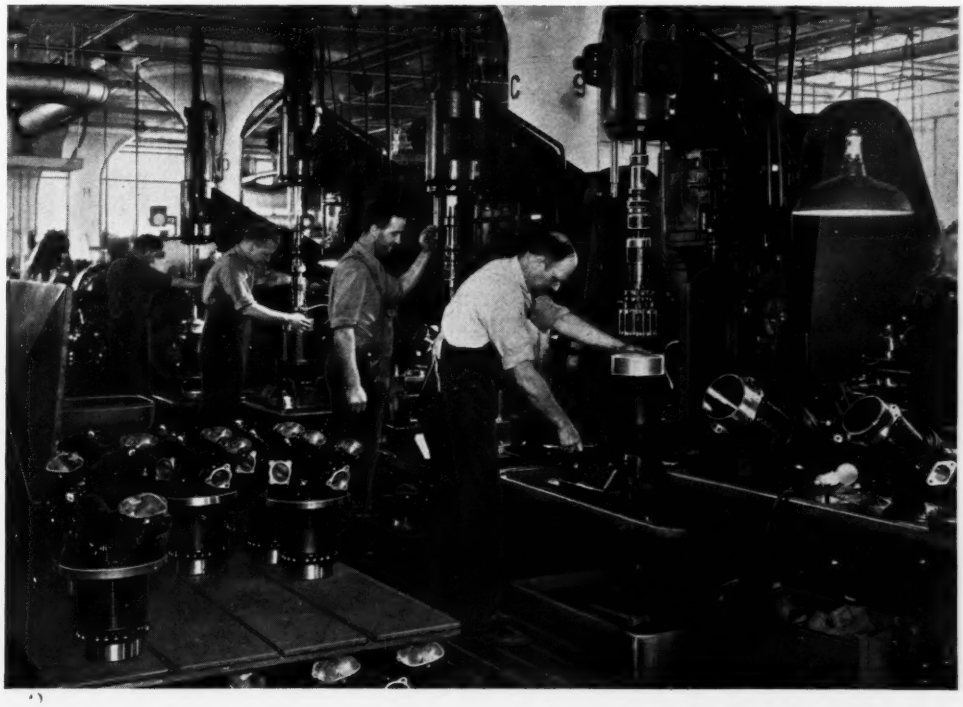
Even in this country where peace is still jealously guarded, factories are busy turning out armaments. The pictures on this page are typical of the plants which are re-arming our own fighting forces while at the same time trying to satisfy the appetite of the allied powers.

The engineer, holding as he does the key positions of the heavy and chemical industries of the world, is often accused by short-sighted persons of making the horrors of war possible. It is true that his knowledge is essential in the armament shops, but equally essential are the orders which start production in the first place. The engineer slips easily into the manufacture of such materials as explosives, gases, ships, airplanes, and tanks since they are merely adaptations of products first invented and perfected for peaceful use.



Radial Drilling Machine being Used in the Boeing Plant for an Operation on a Landing Gear Part for a Flying Fortress. The Machine is Equipped with an Indexing Jig.

Right — **Boring the Cylinders of Radial Air-cooled Airplane Engines by Precision Machinery.**



Left—**Gun Tubes up to 25 Feet Long can be Handled by This "Super" Gun Boring and Turning Lathe.**

Cuts Courtesy of *Machinery*

The Cornell Engineer

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Editorial

At the close of last year, after the excitement of the engineer's annual Cornell Day show had abated, the Engineering Show Committee met and decided that a better system was needed for the appointment and perpetuation of the committee. Feeling also the need of a standing committee to supervise and direct the student activities of the college, Bonham Campbell drew up and presented a constitution for such a council, and a group of Juniors was selected as a nucleus of this body.

The other day, these men met and formally adopted the constitution which provides for a body of fifteen men to be known as the Student Engineers' Council, whose activities shall include the management of such events as the Cornell Day Show, the Engineers' Ball, and any other similar events which come up from time to time. The membership is composed of ten students, four faculty members, and one representative of the Dean. Each of the four Engineering Schools has three representatives, namely a faculty member, a senior and a junior; and the CORNELL ENGINEER is represented by one senior and one junior board member.

The present members of the Council are Joe Coors, Ch.E., President, Prof. Moynihan, M.E., Prof. Chamberlain, E.E., Prof. Winding, Ch.E., Dr. Hawkins, C.E., Mr. Howes representing the Dean, Dean Wallace, M.E., Paul Swatek, C.E., Crawford Adams, E.E., and Beach Barrett, M.E., representing the ENGINEER. Student membership on the Council in the future is to be determined by vote of the juniors in the respective schools, nominations of not less than two men from each school being made by the existing Council. The juniors will be elected in the fall of each year, and will continue in office until the end of their senior year. Nominations for members of the Council will be announced in the near future, and elections will be held in the separate schools throughout the week of November 27.

The Council has been active this year, mainly in connection with raising money for the coming Cornell Day Show and also with the Thurston Centennial. The Council helped in the Thurston Centennial by getting ushers, publishing the pamphlet distributed to students, providing rooms in fraternities for some of the guests, and getting fraternity support.

It is the hope of the present Council members that the juniors will elect their representatives with the idea in mind that they will have a great deal of work to do for the show, such as raising money, supervising the exhibits, publishing the program, obtaining publicity, appointing guides, and so on. Votes should be given to the men most willing and able to do a good job, and the nominations of the Council will be made on this basis alone.

COLLEGE NEWS

The following men were elected to Tau Beta Pi, honorary engineering scholastic society:

Class of 1940
William Gay, C.E.
Roland Graham, C.E.
Bruce Nelson, E.E.
John Flynn, M.E.
William Habicht, M.E.
Martin Goldstein, M.E.
James Frank, A.E.M.E.
Henry Rose, A.E.M.E.

Class of 1941
Noland Blass, Jr., Arch.
Robert Pressing, Chem.E

LAST month we were surprised to discover a large number of engineers on the football team, and this month we decided to look into another type of activity on the Hill to see how many engineers were represented. Our choice fell on the managerships—we found that the engineers who are managers also hold many other honors. W. Dean Wallace, '40, the varsity football manager, is Vice President of Tau Beta Pi and member of Atmos, Red Key, Quill and Dagger, and Football Clubs. John W. Magoun, '40, manager of basketball and frosh football, claims membership to Kappa Tau Chi, Sphinx Head, and Aleph Semach. James R. Riley, Jr., '40, manager of cross-country, was recently elected to Quill and Dagger, and is a member of Atmos. Joe E. Griesedieck, manager of frosh baseball and golf has put his ability to good use as a member of Quill and Dagger, President of Kappa Tau Chi, and member of Tau Beta Pi, Red Key, Golf Club and pistol team. Another basketball manager, Henry M. Ross III, '40, junior varsity manager, is a member of Kappa Tau Chi, Scabbard and Blade, and the Crew Club. E. Hamilton Swazey, '40, although busy as manager of polo, has found time to work on the freshman advisory committee. John T. Collins, member of Atmos and Red Key, has made his mark as manager of frosh track. Other honors for William Dixon, '40, Varsity Soccer manager, include Red Key, Atmos, Scabbard and Blade, Pi Tau Pi Sigma, and Sphinx head.

Note, you freshmen and sophomores, that to each of these Engineers the managerships have opened ways to other honors. So to you, who are neither athletes nor promising men in other fields, a managerial competition may be the pathway to your success at Cornell.

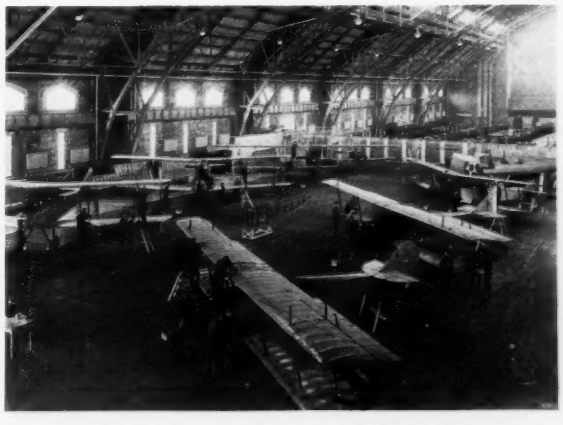
Now that the Civil Aeronautics Authority has authorized Cornell as a training center, we expect that some of the engineers will lay aside slide rules for parachutes in the afternoons. Included on the page is a photograph of the last time Cornell had such a course. You can recognize the Drill Hall and the airplanes of world war vintage. Professor W. N. Barnard has been approved director and Professor C. W. Terry instructor for this civilian pilot training program.

The equipment of the mechanical laboratory has been swelled recently by the addition of a new 15-ton refrigeration machine capable of producing refrigeration equivalent to that of melting 15 tons of ice every 24 hours. The machine, manufactured by the Frick Machine Company, is distributed by the Mollenberg and Betz Machine Company (Richard H. Mollenberg, ME '27).

The machine is located in the West Mechanical Laboratory and will be used to prepare artificial atmospheres in an insulated constant temperature room at temperatures ranging from 40 degrees below zero to 100 degrees Fahrenheit. Model homes and buildings will be erected in this laboratory, and their heating and ventilating systems tested under various "weather conditions". When we stepped into the constant temperature room, the thermometer registered zero, and after a few moments we were glad to resume the investigation from the outside.

According to Dr. David Dropkin, of the Experiment Station Staff, this new unit, which will be used chiefly for graduate research and commercial testing, will find another important use in testing the viscosity of lubricants at various temperatures.

As there are only about ten such experimental labs in the country, it is an important step toward new



Ground School Held In The Drill Hall During 1917-18.

developments in one of our newest industries, air conditioning.

The following men were elected to Atmos, honorary mechanical engineering society:

Class of 1940

John E. Billings
William H. Habicht
Leonard W. Hanson
Robert F. Pigage
Morton A. Serrell

Class of 1941

William T. Hagar
Jean Leinroth
Norman T. Nelson
Richard L. Stimson
Alexander E. Walker

A pleasant time was had by all the AE's at the smoker held by Kappa Tau Chi particularly for the frosh. Professor Magoun of M.I.T. and Dean Kimball gave interesting talks and the A.E. faculty was introduced. Refreshments were served after the proceedings. Congratulations to Mr. Louis S. Bock of the AE faculty who was elected to honorary membership in Kappa Tau Chi.

Under the guidance of Eta Kappa Nu, honorary electrical engineering society, elections were recently held to name the honor committee in the School of Electrical Engineering. This committee will have full supervision and jurisdiction of the revised honor code of that school.

The ASME was fortunate to have for their second meeting October 24th Professor A. G. Christie, national president of the ASME, who spoke on Creative Engineering. At the third meeting on November seventh Professor C. W. Terry of the Engineering faculty gave an interesting lecture entitled, "Gliders and Motorless Flight" with reference to early experimentation with gliders at Cornell. On November 21st, Mr. Harte Cook lectured on Diesel Engines.

The ASCE is another active society. On November 17th Professor Eugene Andrews and Professor Malcolm spoke. On October 31st the members learned about fireproof construction from Mr. T. L. Fleming, Superintendent of Fire Underwriters of the Department of Commerce. Dean Hollister addressed the members November 15th on the construction of the Boulder Dam, illustrating his lecture with slides.

The AIEE's gathered together November fourth for a very successful faculty-student smoker. A large attendance, cider and doughnuts, and sound movies all contributed to a very pleasant evening. "Television" was the topic of one reel of movies, and the other, "Air Waves", pictured behind-the-scenes activities of a large modern broadcasting center. For the regular meeting held November 17th, Professor C. L. Dawes, Vice-President for the Northeastern District, spoke briefly on the work of the Institute. Dr. E. M. Guyer, in charge of Dielectric Research at the Corning Glass Company of Corning, N. Y., spoke on "Electrons in Glass Houses". An authority on the field of dielectrics, Dr. Guyer told an interesting story of the electrical application of glass. Especially interesting was his description of the high-frequency welding of glass, one of Dr. Guyer's own developments.

A drive for new members is now in progress with emphasis on a new type of membership. Starting this term, sophomores and juniors, instead of belonging to the national society, become members of a Cornell group which is affiliated with the local chapter of the Institute. They will enjoy practically all the privileges of national membership but at a lower cost.

With a large attendance of 200 men the A.I.Ch.E. opened their 1939-40 activities at a dinner in Willard Straight. On November 14, at their second meeting, they made plans for a membership drive, for inspection trips to be made during the year, and for future meetings.

Our congratulations to the men elected to Tau Beta Pi and to Atmos. The initiation banquet was scheduled for the first of this month. The Atmos initiation banquet took place on November second and ended with a rush to the movies of the Ohio State game. They planned to hold a student-faculty dinner on December sixth.

The following men were elected to Eta Kappa Nu, honorary electrical engineering society:

Class of 1940

Edward C. Yeaton

Class of 1941

Edward E. Friedrich
William C. Flickinger
Kenneth A. Kesselring
Thomas F. Muchmore
Richard J. Newman
Elliott D. Nichols
John T. Riday

RIGHT OR WRONG?

A 2-minute test for telephone users

1. Bell Telephone engineers are making exhaustive studies of solar data from observatories all over the world.

RIGHT ☐ **WRONG** ☐

2. Radio network programs are transmitted from studios to broadcasting stations over regular telephone circuits.

RIGHT ☐ **WRONG** ☐

3. Twenty years ago, putting through a long distance connection took about three times as long as it does today.

RIGHT ☐ **WRONG** ☐

4. Lowest telephone rates to most out-of-town points are available every night after 7 P. M. and all day Sunday.

RIGHT ☐ **WRONG** ☐

ANSWERS:

1. *Right.* They're learning how and why sun spots affect radio telephony, in order to give you better overseas and ship-to-shore service.

2. *Wrong.* Broadcasting stations are linked by more than 60,000 miles of *special* circuits, developed to transmit the extremely high and low frequencies of music.

3. *Wrong.* Since 1919 the average time for making a long distance connection has been cut from 10 minutes to 1.4 minutes.

4. *Right.* Why not telephone your family or distant friends oftener?

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Carrier Corporation, Syracuse, N. Y.

JOHN P. SYME '26, Vice-President
(New York Regional), New York, N. Y.

FURMAN SOUTH, JR., '12, Vice-President
(Pittsburgh Regional), Pittsburgh. Pa.

PAUL A. REYNEAU '13, Secretary-Treasurer
107 East 48th Street, New York, N. Y.

HERBERT B. REYNOLDS '11, Recording Secretary
New York, N. Y.

"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

•

President's Column

Fellow Engineers:

On my recent return from South Africa, I find that my associate, the real acting head of this Society, Mr. John P. Syme, has carried out most ably his promise to bat for me during my absence. He has given you much of the news of the Society and a restatement of its aims.

It is my plan to devote this column in the next four issues to a discussion of some ideas of engineering education in general, and Cornell engineering education in particular, from the employer's point of view. The plan has been discussed with Dean Hollister and has his support. I hope that the ideas presented may give Cornell engineering alumni and students a better appreciation of the aims of education toward which Cornell strives. The more important purpose of these letters, however, is to try to awaken alumni interest in the character of technical education desired.

The curricula of an engineering college and to a degree the character of the instruction are not, as commonly supposed, determined solely by the desires of the faculty. They must, to a practical degree, yield to the desires of parents and students. It has been my observation that the ideas of the prospective students and their non-technical parents regarding the purposes and requisites of a technical education, are usually very faulty and unsound. As a result, pressure by this group on the colleges has often led to curricula and undergraduate instruction which are undesirable. The alumni should help to combat this tendency.

The primary aim of a technical education should be to train the student in logical thinking and develop his creative imagination. It should be aimed primarily toward the acquisition of power rather than toward the amassing of factual knowledge.

The trend toward following the latest educational fad of the day to the injury of sound, basic education, it seems to me, is a serious problem in all of our engineering colleges, Cornell included. It is the consensus of opinion of employers of technical graduates that specialization in an undergraduate course is highly undesirable for the following reasons:

1. It takes valuable time of the students which is far better employed in obtaining a more thorough understanding of, and training in, the fundamentals of engineering and their broad, rather than specialized, application. Our courses in technical colleges are already over-crowded and are in need of simplification.

2. An over-crowded curriculum leads to superficiality rather than thoroughness. Above all things, the engineer must be *thorough*. It should be the aim of the college to teach thoroughness . . . and then more thoroughness. The habit of thoroughness, through practice, is one of the things that the college can most successfully teach to students of all grades of mental capacity. Thoroughness, which includes thoughtfulness, should be the first objective of engineering training. According to the experience of employers, if thoroughness is acquired, other features of education are relatively unimportant. Factual and specialized knowledge is attained rapidly with opportunity in the graduate's chosen field.

3. With few exceptions, current engineering practice in special fields cannot be taught successfully to undergraduates. The newer arts are advancing with exceeding rapidity and text books are out of date almost before they are printed. Such courses can only be taught successfully by specialists who are practicing engineers, therefore as lecture courses, otherwise methods and facts presented are incorrect or out of date and sometimes the effort expended in such courses by the students is worse than wasted. It is much better that he should gain his specialized knowledge in actual practice. In any event, it will be several years after graduation before he is able to command leadership in his chosen specialized field and here he will have ample time to acquire the specialized knowledge demanded.

4. Probably more than 90% of the students do not follow the field that they have specialized in when at college. Circumstances and opportunity for employment play the most important point in the ultimate selection. In other words, 90% of the time and

(*Continued on page* 31)

ALUMNI DOINGS

Transportation is America's second largest industry. And in these days when things are again going places, it is of interest to note some of the Cornellians who hold key positions in this great field.

The first thing necessary to make things move is motive power, and in this connection there is Otto V. Kruse '09 CE who is general sales manager of The Baldwin Locomotive Works at Eddystone, Pennsylvania. Formerly general sales manager of the Baldwin Southwark Corporation, Mr. Kruse has been employed by Baldwin and its subsidiaries for many years. While at Cornell, he participated in many extra-curricular activities, namely the Banjo and Mandolin Clubs, Scalp and Blade, Semaphore, an honorary Civil Engineering society, many class committees and his class football team. He is a member of Zodiac and Alpha Tau Omega Fraternities. On one of his trips to Wells College, he met his future wife, Adelaide Cathill, Wells '12. Both of his sons, William C. Kruse '38 and Raymond W. Kruse '41 have entered Cornell. A news item of October 7 mentions that Mr. Kruse has been elected to the board of directors of General Steel Castings Corporation.

Also with Baldwin in the capacity of Chief Engineer is Ralph J. Johnson '12 ME. At Cornell Mr. Johnson was a member of Phi Gamma Delta, Cap and Gown Committee, and his Class Sergeant at Arms. He served his apprenticeship in the shops of The Baldwin Locomotive Works at Philadelphia and at Eddystone. During the War he served as Major, Ordnance Department, in France. Dusty memories may be recalled by this quotation from the 1912 *Cornellian*:

"'Rip' hails from Missouri, which explains why he has to be 'shown' everything. Not being attentive when calculus was being shown, he almost fell out of line for a sheepskin, but he is at last on the road."

Among those who make the trains operate are Collingwood B. Brown, Jr. of the class of 1901 and John E. Armstrong, of the class of 1908, who hold the positions of chief engineers of Canada's two major railroads. They held the important responsibility of shuttling the King and Queen of England back and forth over Canada's 3000 miles during their recent visit.

Upon graduation from Cornell, Armstrong went to Cleveland where he became assistant on the engineering corps of what is now the Pennsylvania Railroad. In 1912 he went to Canada and became an assistant engineer with the Canadian Pacific Railway. He was appointed to assistant chief engineer in 1928, the position he held until being promoted to chief engineer this year.

Brown, immediately following his graduation from Cornell, went to Canada, spending his first year as draftsman and rodman on construction work. After a succession of engineering jobs in various parts of Canada, Brown spent four years as division engineer

CORNELL ENGINEERS IN INDUSTRY

Atlantic Refining Company

Carroll B. Barbour
A. Edson Birch
Terance Blake
Wm. L. Bowser
John S. Custer
Thomas G. Delbridge
Henry F. Dure
Frederick B. Ferris
Seymour W. Ferris
Samuel H. Hamilton
Howard H. Ingersoll
William H. Irish
John D. James
Karl G. Krech
William C. Kruse
Robert H. Lummis
Charles D. McLean
Edmund C. Newton
William Schrieber
Donald B. Spanogle
William F. Stolz
Floyd Todd
Len P. Warner
Thomas C. Wilson

in charge of the eastern division of the Canadian Pacific. In 1913 he joined the Canadian Government as assistant general manager and chief engineer.

The 1940 John Fritz Gold Medal, one of the highest engineering honors in the United States, has been awarded posthumously to Dr. Clarence F. Hirshfeld, '05, for 11 years a member of the engineering faculty at Cornell. The medal is given annually for notable scientific or industrial achievement. For 26 years before his death on April 19, 1939, Dr. Hirshfeld was chief of research of the Detroit Edison Company. Among the many engineering advancements credited to Dr. Hirshfeld is the complete modernization of the electric street car from wire to track.

Cornell has produced more than her share of noted writers, who have for many years been writing about their University. The articles and poems about Cornell by such famous authors as Hendrik Willem Van Loon, '05; Morris Bishop, '14; Dana Burnett, '11; and Thomas S. Jones, Jr., '04 have been collected, carefully edited to avoid duplication and to bring them up to date by Raymond F. Howes, '24 and published in a volume illustrated by Margaret Bourke-White, '27 staff photographer of *Life*.

You may get *Our Cornell,* beautifully bound in red cloth and stamped in gold, for one dollar. It is available at all Ithaca book stores.

HERE AND THERE WITH ALUMNI

'98 ME—CHARLES W. GENNET, JR. had an article in a recent issue of *Armour Engineer and Alumnus* on "Detection of Fissures in Steel Rails." Gennet has been vice-president of Sperry Products, Inc., since 1928 with the rail service division.

'98 ME—FREDERICK W. MIDGLEY has retired after thirty-eight years as engineer with the Otis Elevator Company in Yonkers, where he lives at 11 Saratoga Avenue. He and Mrs. Midgley returned in July from a six-week's trip through the Panama Canal to San Francisco, the Fair, and Los Angeles, where they visited CLARENCE M. ESHELMAN '98. They returned by way of Yosemite, Grand Canyon, Boulder Dam, and Yellowstone Park.

(*Continued on page* 29)

Projects by Detroit Edison Cornellians.
These are projects in which Cornell graduates have participated – in design, operation or maintenance.
Delray #3
Trenton Channel
Conners Creek
The Four Large Steam Power Plants of The Detroit Edison Company
Marysville
Trenton Channel Boiler Room
Cornellians in The Detroit Edison Company include
The Service Building
Trouble on The Overhead Lines
Cultivator
Plastic Flow Box

Detroit Edison Company

Wilber A. Carter
George B. Catlin
Harold Cole
John W. Drummond
Leslie V. Grantier
Arthur S. Griswold
Pearl E. Landback
James N. Livermore
Frank Nitzberg
James W. Parker
George A. Porter
William G. Stolberg
John H. Stressen-Reuter
Paul W. Thompson
Myron Zucker

Use The Cornell University Placement Bureau

WILLARD STRAIGHT HALL — H. H. WILLIAMS, '25, Director

FACULTY FORUM

PROFESSOR C. W. ARMSTRONG

The popular humorous belief that all faculty members do is to play golf and grade prelims is certainly exploded by a review of the duties and activities of Professor Cecil W. Armstrong. In addition to carrying his teaching schedule in mechanics and hydraulics, he serves as class adviser to the Junior M.E.'s, and is actively engaged in research work in hydraulics. His recent appointment as secretary of the Engineering Experiment Station at Cornell necessitates familiarity with much of the research being carried on.

Because of his complete lack of a southern accent, one would never suspect Prof. Armstrong of having been born and raised in the heart of Oklahoma's oil fields. Although he entered the University of Oklahoma as an electrical engineer, he transferred and graduated in 1932 as a mechanical engineer. The outstanding record he achieved in college was evidenced by membership in Tau Beta Pi and fifteen other activities and honorary societies. It is interesting to note that the present Mrs. Armstrong was a former University of Oklahoma co-ed.

His first job upon graduation was a position with General Mills, Inc. as a Junior Field Auditor. In this capacity he traveled around the country inspecting mills, granaries, and factories, auditing records, and studying operations of milling companies. Valuable field experience gained here led to a position as credit manager of The Burdett Oxygen Company, manufacturers of industrial gases. As a sidelight, it might be mentioned that accounting applied to engineering, a subject which he admittedly detested in college, was responsible for the first two jobs he held upon graduation.

Having had experience as student instructor in mechanics at the University of Oklahoma, he accepted

PROFESSOR C. C. WINDING

This young midwestern professor finds only one fundamental difficulty in sailing, the same which he has been encountering for the past couple of seasons or so. That obstacle is the fact that he hasn't yet found a boat he likes well enough to pay for. Those that he has seen for sale are usually too large for one man to handle, while those of suitable length are either too costly or intricate. But one day the right boat will come his way, and the blue waters of Cayuga will be furrowed by a gallant and graceful sailing vessel, tacking and a-Winding up and down the lake. Until such time as this, however, he will content himself with other recreations, such as badminton, squash, or golf, and put in extra time on research work in the development of an adsorbent, preferably synthetic, for refining the lubricating oil of a certain petroleum company. This adsorbent will have the property of removing the coloring matter and impurities inherent in the crude oil.

Prof. Winding was born and reared in Minneapolis, and was graduated from Minnesota in 1931 with the degree of Bachelor of Chemical Engineering. He remained there four years doing teaching work and securing his Ph.D. He came to Cornell in the fall of 1935 as an instructor chiefly in Unit Operations Laboratory and Chemical Plant Design. With the change in administration from the College of Arts and Sciences to the College of Engineering in 1938, Mr. Winding was promoted to the rank of assistant professor. While at Minnesota, Prof. Winding was Editor-in-Chief of Ski-U-Mah, the humor magazine, and member of Alpha Tau Omega, Alpha Chi Sigma (professional fraternity in chemistry), Tau Beta Pi, Sigma Xi, Phi Lambda Upsilon, Phi Kappa Phi, as well as local honorary societies. Since then he has become a mem-

Professor Armstrong

an instructorship at the University of Kansas. Here his duties included aeronautical engineering construction, laboratory and wind tunnel research. In connection with this, he conducted commercial experiments in aerodynamics and made actual wind tunnel tests on model airplanes, the construction of which was a boyhood hobby. A paper was published upon the results of his aerodynamic research. Summers were spent profitably in the capacity of consultant and power test engineer for three Kansas and Missouri utility companies.

Mr. Armstrong came to Cornell in the fall of 1936 as instructor in mechanics. Promoted to Assistant Professor in 1938, he has done research work in photoelasticity, resulting in a published work in the A.S.M.E. transactions and a thesis for the M.S. Degree in Engineering. He is at present pursuing and directing research work in hydraulics.

He is also faculty adviser to Atmos, honorary mechanical engineering society, as well as maintaining an active interest in the A.S.M.E., of which he is a Junior Member. In the midst of all his work, he manages to find time for his hobby of photography which, although it might be applied to his work in photoelasticity, is most likely applied to keeping a pictorial record of his young daughter and baby son.

Professor Winding

ber of the American Chemical Society, American Institute of Chemical Engineers, all the national meetings of which he attends, the Society for Promotion of Engineering Education, and Aljebar.

In securing background for one's life's work, believes Prof. Winding, outside activities are just as important as work in school, with the proviso that not too much emphasis is placed on them so that they would effect an appreciable lowering of one's learning powers, pro tempore at least.

Prof. Winding enjoys teaching no end, not only because of the actual teaching part of it, but also because of the research facilities offered. Especially does he like it here, for he is having the opportunity of working in and toward the development of a great Chemical Engineering School.

Mainly because of the success with which the five-year course in Chemical Engineering at Cornell has been met, Mr. Winding sincerely believes that there should be a five-year course in engineering in general. As it is now, the curricula are filled almost to capacity, but there is the growing need for other subjects which are not now included.

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SENIOR SIDELIGHTS

EDWIN PAUL SWATEK, C.E. '40

BETWEEN attending college and spending his summers on a ranch, Paul Swatek has not found much time to be at his home in Chicago, Illinois. He isn't sure which he enjoys more, working on a ranch or studying at Cornell.

Paul had a good reason for coming to Cornell to study civil engineering. The man who founded the preparatory school at Deep Springs, California, which Paul attended, also founded the Telluride Association at Cornell, where he always liked to send "his boys" for civil engineering training so they could come back and help him with the mining. Paul therefore came to Cornell and joined the Telluride Association.

One of Paul's pet hobbies is a 1924 Dodge, which he enjoys driving and repairing (predominately the latter). He has also developed the hobby of drawing cowboy sketches, at which he is quite an artist.

He likes the work and fellowship to be derived from college. Materials Lab and Hydraulics Lab impressed him especially, for he found the testing very fascinating. He has been able to mix studies and extra-curricular activities sufficiently well to become one of the highest in his class scholastically, to become art editor of the *Areopagus,* and to take an active part in intramural athletics. He was elected Secretary-Treasurer of Chi Epsilon, is a member of Tau Beta Pi, Pyramid, and is the holder of a McMullen Regional Scholarship.

Paul is intensely interested in his work and after graduation he hopes to do design and construction work. He believes that the main reason for being in college is to study—extra-curricular activities come second. He loves the West, and although he likes the East almost equally well, he insists there is a certain fascination about the western country—the towering mountains, beautiful lakes, surging waterfalls, and the wide open spaces.

CRAWFORD GRANGER ADAMS, E.E. '40

IF a successful college life is an indication of a man's place in the engineering world, then Crawf Adams is assured of a great career. His scholastic achievements are a source of pride to the college and university he represents. Last year Cornell showed its regard for Crawf by awarding him the Sibley Prize for maintaining the highest scholastic average of either the junior or senior class in the College of Engineering. His average for three years in one of Cornell's most difficult courses, Electrical Engineering, was 91.

Crawf has made more than a high scholastic average at Cornell; he has made many friends and has established a reputation for his leadership. Indicative of the faith and esteem his associates hold for him are the offices he has filled while at Cornell. During his junior year he was manager and treasurer of Alpha Sigma Phi, his fraternity, and this year he is chairman of the A.I.E.E. He also took part in planning last year's electrical engineering show. When studies and activities give him some free time, Crawf occupies himself with interfraternity sports, putting particular emphasis on basketball, tennis, and softball.

If anybody wants a professional job of electric motor cleaning done, just ask for Crawf Adams. He can give the best of references, having worked all of last summer in the electric motor repair shop of the Eastman Kodak Company. Due to the untimely death of his father, Crawf spent the summer of his freshman and sophomore years managing his family's farm, which is located near Sodus, New York. Since Sodus is on Lake Ontario, Crawf found it possible to enjoy a great deal of sailing in the spare time of his summers.

This versatile young man has achieved the status of a first class radiotelephone operator and has also been able to put in time at the Ithaca Airport for his pilot's license. Crawf is a holder of the State Cash and Cornell University Scholarships and is a member of Eta Kappa Nu and Tau Beta Pi.

THE LION'S GATE BRIDGE

(*Continued from page* 12)

along the catwalk to restrain the main cable strands when they were pulled across. To prevent vertical oscillation of the walkways, storm cables were attached to the catwalk cables in the form of an inverted arch secured to the main towers, tension being kept on them by weights.

The two main cables are made up of 61 1-7/16 inch diameter strands each, and when completely assembled and wrapped are 13¼ inches in diameter. Each strand, weighing about 8 tons, was on a separate reel and they were shipped to the north end of the bridge by truck. An 8-ton derrick was employed to handle the reels; the strands were hauled across the catwalk by a ⅞ inch cable operated by a hoisting engine on the south anchor pier. Hardwood rubbing plates were provided at the tops of the towers and at the sides of the saddle to protect the galvanizing on the strands during hauling operations.

As the catwalk was from 4 to 5 feet below the cable when it was supported by the saddles, there was sufficient slack in the strands to allow connections to the anchorages to be made without difficulty, as the strand was lying on the catwalk as these connections were being made. After the strands were connected to the anchorages, they were lifted simultaneously over the four saddles by means of five-ton derricks located on top of the towers.

After final adjustment of the four guide strands (two for each cable), the remaining three strands of the first layer of each cable were erected and adjusted to the same elevations as the guide strands. Subsequent layers were then erected, slightly higher than their final position, and carefully adjusted until they just touched the previous layer. There are nine layers of strands starting with five for the first layer, six for the second layer, and so on until nine for the middle layer and back to five for the top layer, making 61 strands in all for each cable.

The partially completed cables were tied to the handrail posts of the catwalk to prevent chafing during high winds. The total weight of the cables is about 480 tons each. During erection, lights were installed at the top of the towers, at the center of the main span and on the under side of the center storm cable as a precaution against aerial traffic. Steel clamps for adjusting the cables were provided with sections of rubber hose to go over the cable to protect the galvanizing. Adjusting the cables had to be done when there was no sun and no wind, and as the weather was very fine during the erection of the cables, all adjusting had to be done at night.

These are the longest stranded, prestressed suspension bridge cables in the world, while the center span is the longest in the British Empire.

The cable bands were next erected, being lifted to the tops of the towers and skidded down the catwalks on sleighs. They were in two sections and were lifted by hand to their position on the cables and the bolts tightened. There were 166 complete bands. The suspender ropes were also taken to the tops of the towers, slid down the catwalk, and erected by hand.

The stiffening trusses were next put in place, the main span trusses being loaded on barges, towed to the site, and lifted into position. Then the side span trusses were erected. The erection of the floor system was carried out in a similar manner to the erection of the stiffener trusses. The floor was welded T grid construction, 3 inches deep.

On this the concrete deck was poured. Concrete was lifted from the ground to the deck at the south end of the north approach, from which it was distributed by trucks.

The cables were wrapped and painted a red orange color for greatest visibility for aerial traffic. A signal bridge is located at the center of the span for marine traffic and observation platforms are provided outside the trusses at the towers.

Ed. Note. This article is a condensation of a speech given by Mr. Cushing before the Ithaca Section of the A. S. C. E. on the evening of November 15, 1939.

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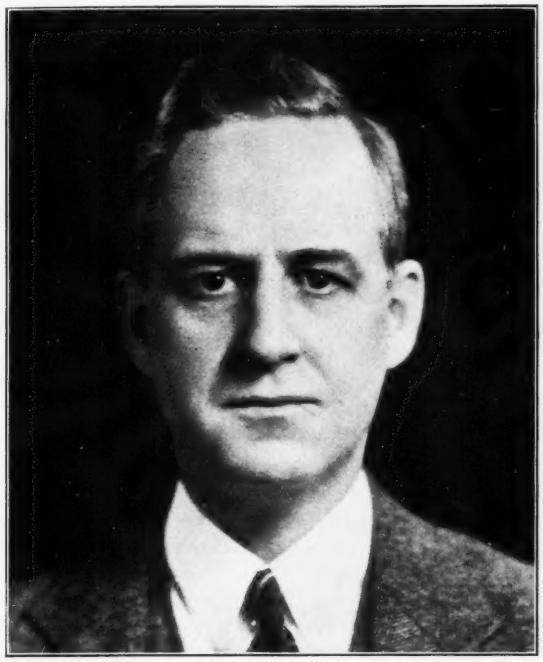
ALUMNI DOINGS

(*Continued from page* 24)



'04 ME—WALTER S. FINLAY, JR. has been appointed vice-president of the J. G. White Engineering Corporation, New York City. For the last twenty years he has been vice-president and director of the American Water Works and Electrical Co., directing the engineering plans and policies of the firm's electrical subsidiaries. Prior to that he had charge of engineering and operation of the power division of the Interborough Rapid Transit Co. Other Cornellians in the firm are JAMES G. WHITE, PhD '85, president, JAMES D. WHITE '10, CLYDE D. GRAY '00, and FORD KURTZ '07.

'08 ME '20—ALVAH A. SCOTT, former manager of the Honolulu Plantation Co., last April became vice-president and general manager of the Mutual Telephone Co., Honolulu. T. H. Scott had been manager of the Plantation Company since 1926. Prior to that he was head overseer of the Hilo Sugar Company and supervising director of C. Brewer & Co. STAFFORD L. AUSTIN '20 has taken Scott's place in the Honolulu Plantation Company. He was former manager of Wailuku Sugar Company.

'15 ME—WAYNE W. COWAN works for the Eclipse aviation division of Bendix Aviation Corporation in Bendix, N. J. He lives in Nutley, N. J. at 396 Prospect Street.

'15 ME—WINTHROP KENT has a hobby which has brought him recognition in Buffalo, where he is a department store executive. Buffalo Courier Express recently pictured him at work in his fully-equipped cabinet shop on the third floor of his home.

(*Continued on page* 30)

The well-known Lufkin ease-of-use features and accuracy are perfectly combined with durability in the "Hi-Way." It actually outwears all other chain tapes. Prominent figures are cut into bright portions of the special, tough steel line for longer life and easier reading. See it at your dealers.

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ALUMNI DOINGS

(*Continued from page* 29)

'12 ME—RALPH P. JOHNSON has recently been appointed chief engineer of the Baldwin Locomotive Works at Eddystone, Pa., where he has been employed since his graduation.

'15 ME—HAROLD W. FLETCHER was appointed vice-president and general manager of the Hughes Tool Company in Houston, Tex. For the past twenty-two years Fletcher has been chief engineer of the company, said to be one of the largest manufacturers of oil field equipment in the world.

'16 ME—MALCOLME G. ALLISON is working in the test laboratory of the United States Navy Yard, Brooklyn. He lives at 344 West Twelfth Street, New York City.

'16 CE—HARMON C. KIBBE has a daughter, Virginia Adelaide, born July 31. He is a member of the firm of Cobbledick-Kibbe Glass Co. and lives at 301 Washington Street, Oakland, Calif.

'17 ME—JOHN L. COLLYER was elected Sept. 12 president of the B. F. Goodrich Co., Akron, Ohio. Since 1937 he has been managing director of the Dunlop Company, Ltd., in London, England. Previously he worked for the Bethlehem Shipbuilding Co. and from 1923-29 was vice-president of the Dunlop Tire and Rubber Co. in the United States. Collyer stroked several Cornell crews and later came back as coach. In 1931 he became the Cornell representative on the board of stewards of the Intercollegiate Rowing Association.

'17 MME—CHARLES E. OAKES has been elected recently to the presidency of the Birmingham Electric Company, Birmingham, Alabama. He will also serve as general manager. Until this promotion, Mr. Oakes had been employed by the Pennsylvania Power and Light Company since 1923.

'22 EE; '93 ME—JUNIUS F. COOK, JR., son of the late Junius F. Cook '93, has resigned from the law firm of Cox & Moore and has become associated with Richard Spencer, Richard L. Johnston, Wilfred S. Stone, and John A. Marzall, in the practice of patent law, 135 South LaSalle St., Chicago, Ill.

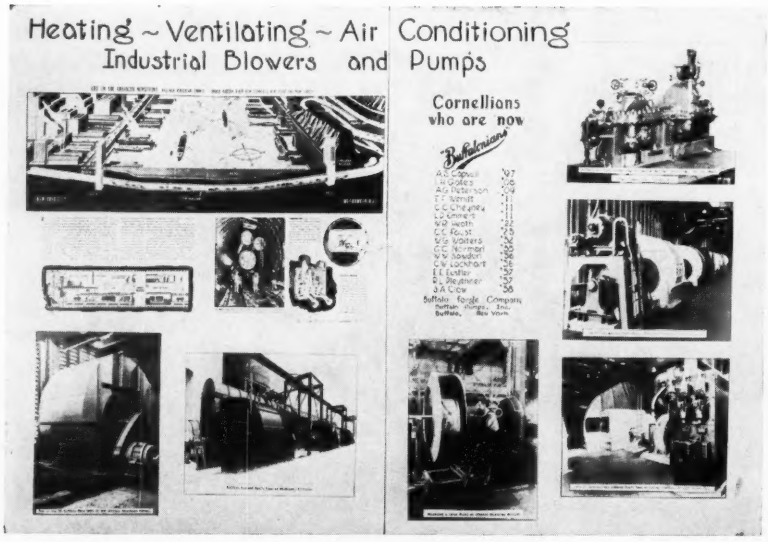
'24 EE—ROBERT C. GORHAM, associate professor of electrical engineering at the University of Pittsburgh, is the author of a textbook, *Power Economics for Engineering Students,* published the end of June by Pittsburgh Printing Co., 530 Fernando Street, Pittsburgh. Pa. Professor Gorham has been at Pittsburgh since 1925.

'26 ME, '33 MME—GEORGE G. GUTHRIE is employed by the American Gas & Electric Service Corp. in New York City. His home is at 111 Collidge Street, Westfield, N. J.

'28 ME, '29 MME; '97 ME—JOHN B. MORDOCK has been for three years manager of the Sears, Roebuck & Co. retail store in Cumberland Md., where his address is 407 Washington Street. Mrs. Mordock is the former Nancy James of Cumberland, and they have a son, John B. Mordock, Jr. born August 2, 1938. Mordock is the son of Charles T. Mordock '97.

'29 EE—ROBERT F. SCHUETZ has been recently made manager of the National Broadcasting Company Transcription Service, with his office in Hollywood, California, after ten years' service with that company in its Engineering Department.

'31—RICHARD C. McBENTLY is the father of a second daughter, Barbara Augusta, born on November 8, 1938. He is an engineer with the General Fireproofing Co. in Youngstown, Ohio, and lives at Bentwood, Ravine Drive, Youngstown.



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George C. Norman
Will W. Sawdon
Charles W. Lockhart

GLIDING AT CORNELL

(*Continued from page* 10)

In June, 1911, an Intercollegiate Glider Meet was held by the Harvard Aeronautical Society at Squantum, Mass. For this competition, Glider No. 2 was constructed, so hurriedly that it was not tested before being shipped. The craft was in the opinion of the Cornell men the best on the field, and while Tufts took first place, it was felt that the pilot rather than the design was inefficient. This same ship was flown 600 feet in October, reaching an altitude of 50 feet. In the fall, each of the three sections began work on a glider. One of these, Glider No. 3, was finished in May, 1912, when a dual meet with Dartmouth was held at Ithaca. By spring, Gliders 4 and 5 were nearing completion. At this time it was planned to build a biplane, a two-seater to be used for instruction and demonstration purposes. Whether this ambitious project reached completion is not known.

The club reached the height of its activities in 1912-1913. Its second annual model meet was held in February, an account of which was published in the Sibley Journal. "All classes of machines were entered. Several biplanes were entered. Monoplanes appeared to be the favorites, however. Besides these common forms, one or two double monoplanes of the Langley type appeared among the entries. Considerable diversity existed also in the number and location of propellors. Some placed the propellors behind, others in front, again some employed one propellor, others two revolving in opposite directions. Most of the machines were built of wood and covered with paper or cloth. An interesting model was presented with planes of sheet aluminum." On Spring Day a show was given and the year concluded with a banquet.

Interest in gliding phase of Aeronautics died out in a few years, the members turning to the study of powered flight. In the impetus given aviation by the First World War, it was completely lost sight of, and was not resurrected until the nineteen twenties, when a successor to this pioneer club was organized at Cornell.

PRESIDENT'S LETTER

(*Continued from page* 22)

effort spent in specialization, except as it may be useful as training in the application of fundamentals and thoroughness, are entirely wasted.

5. It adds unnecessarily to the overall cost of running a technical college. Cost of instruction in and operating laboratories for specialized fields is all out of proportion to the cost of the more important fundamental instruction.

In my next letter I would like to point out the importance of training in thinking rather than memorizing.

Very truly yours,
WILLIS H. CARRIER, *President.*

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STRESS AND STRAIN

Neighbor—"I like your radio. How many controls has it?"

Engineer—"Two. My wife and my daughter."

* * *

Jones—"The report says the man was shot by his wife at close range."

James—"Then, there must have been powder marks on him."

Jones—"Yes, that's why she shot him."

* * *

The quickee of the age is attributed to a chemistry professor. "Measure out cyanide solutions in graduates, not pipettes. If you use pipettes, we won't have any graduates!"

—Pennsylvania Triangle

* * *

Newton's thirty-third law—The dimmer the porch light, the greater the scandle power.

—Nebraska Blueprint

* * *

Idealist—"I'm going to marry an engineer and a gentleman."

Realist—"You can't do that, it's bigamy."

—Pennsylvania Triangle

* * *

Newlywed—"I married a girl with a twin sister."

Bachelor—"How can you tell them apart?"

Newlywed—"I don't bother; the other one has to look out for herself."

—Kansas State Engineer

* * *

"There are lots of couples that don't pet in parked cars."

"Yeah, the woods are full of them."

—Arkansas Engineer

* * *

The district visitor asked, "How many are seven times six?"

"Forty-two," said a small boy.

"Pretty good," replied the visitor.

"Pretty good, hell; it's perfect," said the boy.

—Nebraska Blueprint

* * *

Irritated Mother—"Out you go John, and don't ever darken my Dora again."

* * *

The Eskimo was sitting on a cake of ice telling a story. He finished and got up.

"My tale is told," said he.

.....—The Wayne Engineer

* * *

And the Germans named their ships after jokes so the English wouldn't see them.

—The Kansas Enginer

Guest (to host in new house)—"Hello, old pal, how do you find it here?"

Host—"Walk right upstairs, and two doors to the left."

* * *

"Up and atom," cried the molecule.

* * *

Soph—"What is your greatest ambition?"

Frosh—"To die a year sooner than you."

Soph—"What's the reason for that?"

Frosh—"So I'll be a sophomore in hell when you get there."

* * *

"So you've been to college, eh?"

"Yousah."

"How high can you count."

"One, two, three, four, five, six, seven, eight, nine, ten, jack, queen, king."

* * *

"My girl's got a $100 Mexican hairless dog that's part bull."

"What's part bull?"

"The part about the hundred dollars."

—Kansas State Engineer

* * *

And then there was the guy who was so egotistical that he would kiss his girl good night and say he was the second happiest person in the world.

—Rose Technic

* * *

Professor: Are you teaching this class?

Oscar: No, sir.

Professor: Well then sit down and stop acting like an idiot.

—Washington State Engineer

* * *

Baby ear of corn: Where did I come from mama?

Mama ear of corn: Hush dear, the stalk brought you.

* * *

Guard: The prisoners are rioting again sir.

Warden: What's the matter now?

Guard: The cook used to work in a fraternity house.

—The Kansas Enginer

* * *

One engineer to another: "Grab the end of that wire."

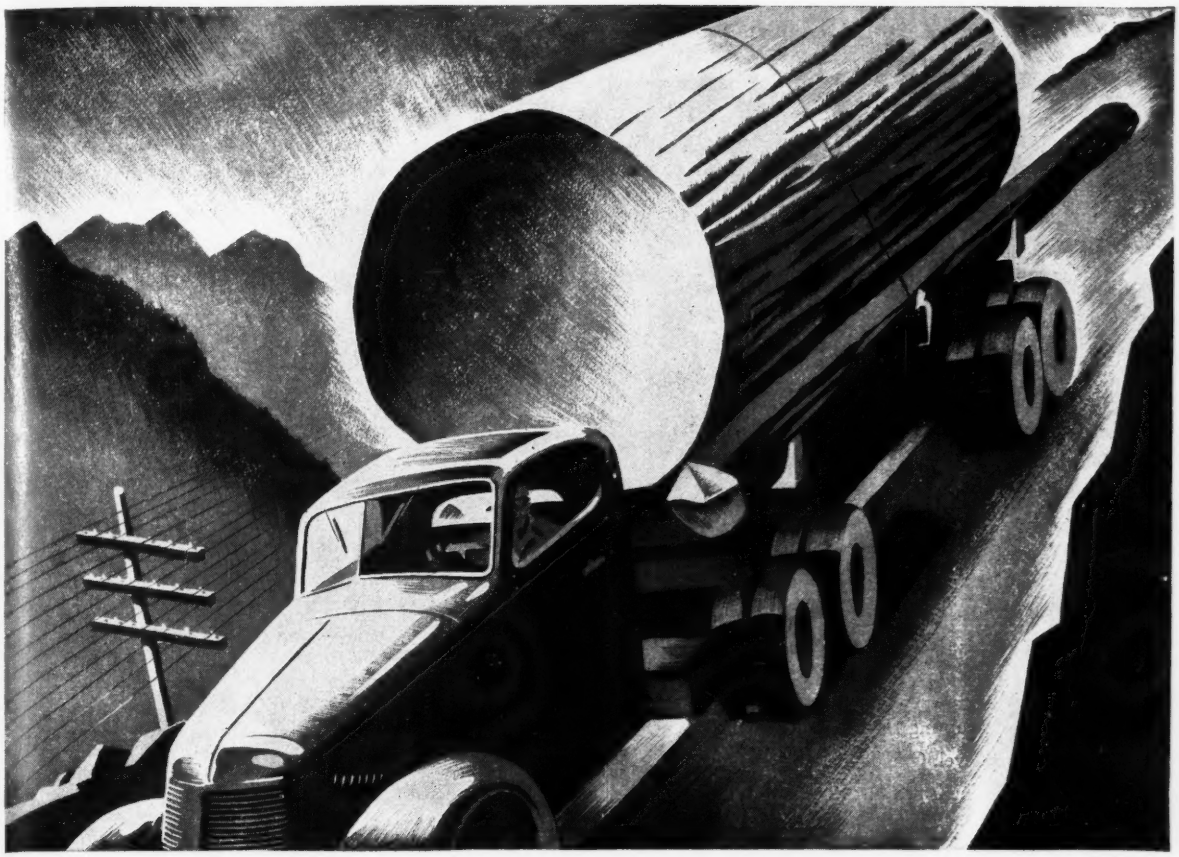
"All right."

"Feel anything."

"No."

"Well then don't touch the one next to it, it's got over 5000 volts."

—The California Engineer



SOLVING THE HARD ONES

Many a design problem that used to be troublesome is being worked out these days by the use of modern materials. Take logging trailer brake drums, for example.

Holding back 50 ton loads on long, steep grades and running high temperatures is all in their day's work. But, by making his drums of Chromium-Molybdenum (0.35-0.45% Cr.; 0.35-0.45% Mo.) iron, one of the leading manufacturers has more than met the severe operating conditions.

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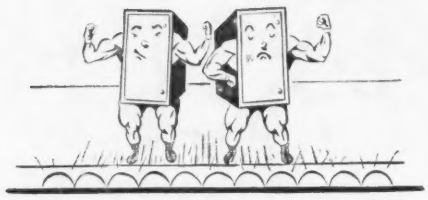
G-E Campus News

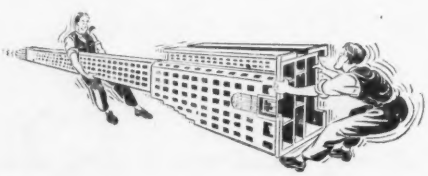


CONQUERING HEROES

TWO newcomers to the G-E family of electric products took the stage recently and proved to 250 industrial, utility, and railroad guests that they could "take it." The pair were oil-less circuit breakers, designed for applications heretofore limited to oil-type breakers.

As are all their brethren, these breakers are designed to protect electric circuits, interrupting those circuits when the current rises to a dangerous level. One of the pair operates magnetically. The other uses high-pressure air. As they should have been, the actual circuit interrupting tests in themselves were properly uneventful. The breakers passed them with ease—even though one test exceeded their interrupting ratings by 50 per cent.

Among those present were three distinguished ex-Test men—E. O. Shreve, Iowa State '04, G-E vice-president in charge of apparatus sales; M. O. Troy, Virginia '96, commercial vice-president and head of the Central Station Department; and D. C. Prince, Illinois '12, head of the engineering department, G-E Philadelphia Works.

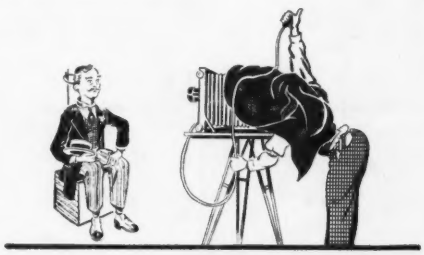


SKYSCRAPER STRETCHERS

NEW YORKERS who have the tallness of their city's skyscrapers neatly cataloged in their minds will soon have some mental reorienting to do. General Electric engineers are stretching the towering G-E building in mid-town Manhattan.

The actual stretchers are four 25,000,000-candlepower searchlights of a type recently introduced by General Electric. Each contains three "midget suns"—1000-watt water-cooled mercury lamps the size of a cigarette. Four of these searchlights are being mounted so that they will send their streaks of bluish-white light up the building's corners, accentuating the structure's vertical lines and creating an illusion of greater height. Under favorable atmospheric conditions the beam will be visible high above the tower.

Thus, G-E illuminating engineers, some of whom only recently completed the Test Course for engineering college graduates, continue to introduce new methods of illumination. Other examples of their work can be seen in all parts of the nation—on highways, buildings, city streets, athletic fields, and hundreds of other places.



SIT STILL, PLEASE!

SOME photographic subjects are the perfection of immobility, but not so the subjects of W. K. Rankin, G-E engineer. He photographs electric arcs, the flashes of electricity that occur when a circuit is broken.

Before he could photograph these arcs, Mr. Rankin had to catch up with them. He designed what is believed to be the world's fastest camera—capable of taking 120,000 pictures per second. The fast-stepping arcs occurring in various types of electric apparatus can now be more closely studied and the product itself improved.

In making the camera it was found undesirable to use glass lenses. Therefore, the pinhole principle was used, employing 1000 holes of .01 inch diameter through which light passes to the film. The camera is its own darkroom, being surrounded by a case large enough to house its operators.

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